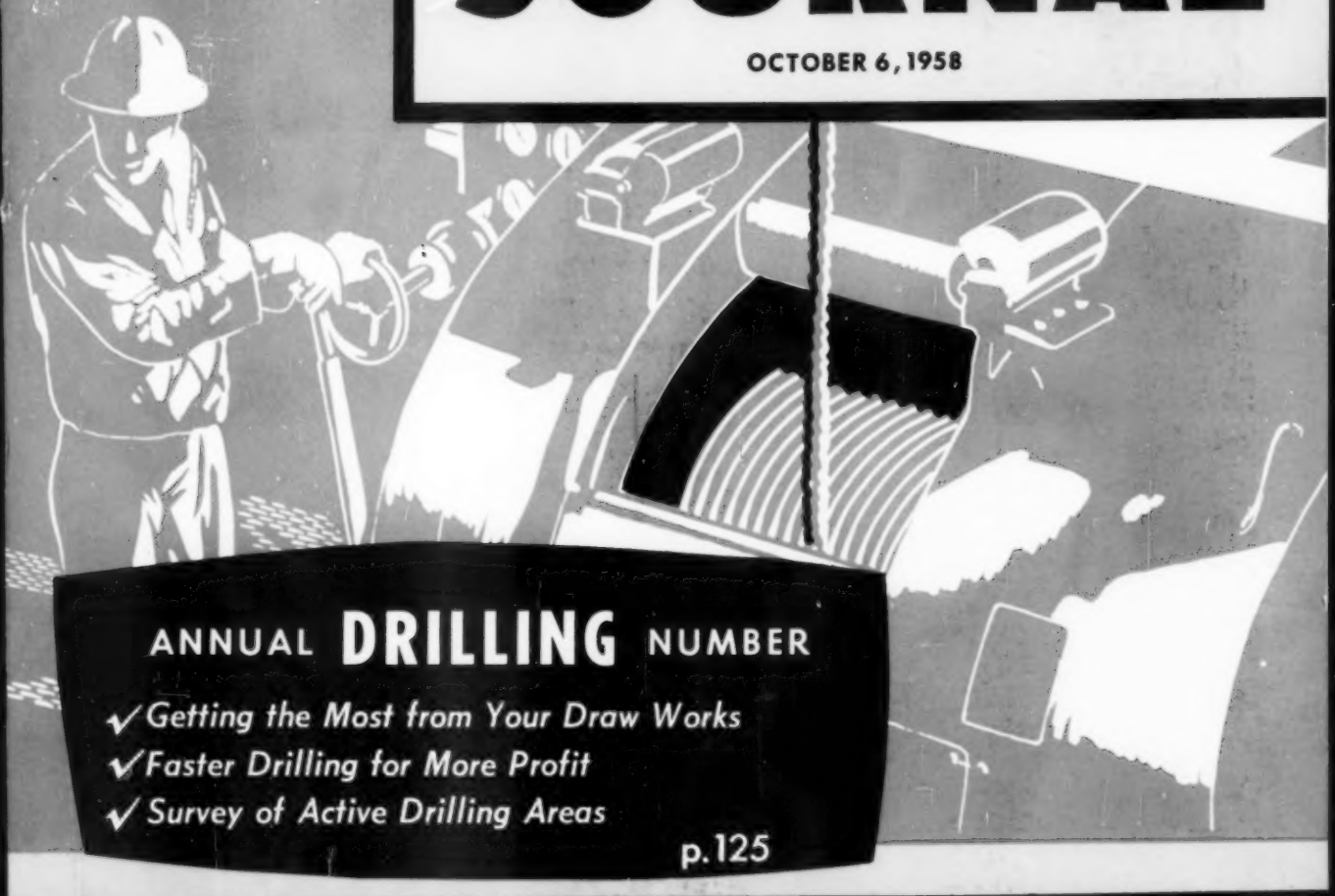
EXPLORATION SECTION p. 287
CURRENT STATISTICS p. 322

the OIL AND GAS JOURNAL

OCTOBER 6, 1958



ANNUAL **DRILLING** NUMBER

- ✓ *Getting the Most from Your Draw Works*
- ✓ *Faster Drilling for More Profit*
- ✓ *Survey of Active Drilling Areas*

p. 125

EXCLUSIVE

How Military Fuel Needs Will Change

. . . an official forecast by the nation's military planners **p. 103**

The Future of the U. S. Oil Industry

. . . a panel prediction by Oil and Gas Journal editors **p. 110**

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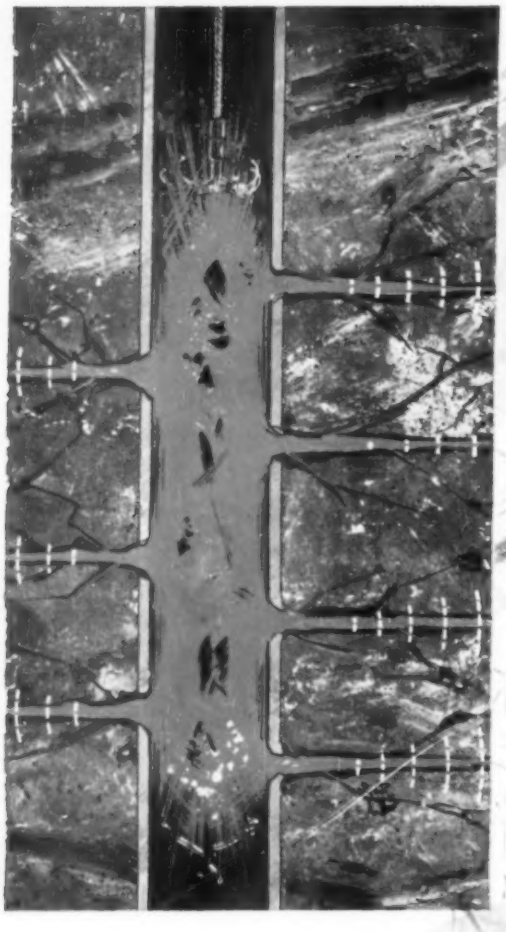

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* *Vibro-Frac is a tradename of Petroleum Tool Research, Inc.*

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the OIL AND GAS JOURNAL Newsletter

Tulsa, Okla.
Oct. 6, 1958

Ford wage settlement hasn't changed wage picture for oil:

Neither has OCAW's optional wage proposal.

In fact, current oil-industry economics still make odds favor management's no-raise policy for 1958.

What did Ford's auto workers get?

Not much. Reuther could have done as well last April.

The union agreed to wage increases based on 2½% annual productivity growth and on cost-of-living allowance plus some improvements in fringe benefits. Pay clauses add 9.5 cents an hour this year to workers' checks with similar increases possible in remaining years of 3-year contract.

But remember: Oil workers' base pay, best in industry, already outdistances that of auto workers. Fringe benefits enjoyed by oil employes make those offered by auto companies seem barbaric.

What is OCAW's new approach to its stalled pay drive?

Wage-policy committee at Long Beach convention decided to give local bargaining units an option. They may negotiate for a flat 25-cent hourly wage raise. Or they may pursue the old plan of a 3½% productivity raise plus cost-of-living allowance.

That's not much inducement to oil management: The new 25-cent hourly goal is more than the original formula which amounted to about 19 cents an hour.

Management also has reviewed its position.

It generally is opposed to the productivity and cost-of-living concept. But more important, the profit and price picture for oil still hasn't improved enough for companies to recapture old costs let alone increased ones.

Auto firms can get back their wage boosts by hiking prices. Oil companies don't stand a chance of doing that.

▼ ▼ ▼

Gas competition is forcing Standard of California to cut prices for fuel oil and heavy crude.

Company sliced fuel oil by 35 cents a barrel, lowering it to the 1956 level. Price reductions for heavy crude ranged

from 50 cents on 14° gravity to no change on 27° gravity.

Full blame for cut is put on gas imports. Company gives this rundown: Gas in 1947 displaced only 15,000 bbl. daily of fuel oil in western states. By 1958, displacement had reached 450,000 bbl. daily. New pipelines and expansion of present lines indicate this gas competition will grow.

With fuel-oil inventories mounting, Standard officials had no alternative but to attempt to make fuel oil competitive.

Fuel-oil demand may really suffer a body blow if a new antismog ordinance is passed by Los Angeles County.

Proposed rule would sharply restrict use of fuel oil in county. Specifically it would prohibit burning oil with more than 0.5% sulfur between May 1 and October 31, and restrict its use rest of year.

Los Angeles County users represent a substantial part of the state's dwindling fuel-oil users.

▼ ▼ ▼

Pickup in steel orders which started in August is still continuing—and all lines are affected.

One major producer says increase in buying reflects one trend: Steel users have reduced inventories to rock bottom and now are being forced to restock.

Pipe mills particularly are in good shape.

Republic Steel's Gasden, Ala., plant, will be busy all winter on one order—94,000 tons or 450 miles of 24-in. pipe. Order was placed by Houston Corp. for new natural-gas line from Texas to Florida.

Other mills are getting orders for projects which expect to get FPC approval early next year.

▼ ▼ ▼

Pipeline builders will be interested in a German process for automatic field welding.

The induction process, designed for welding on the right-of-way, will be demonstrated in Houston soon.

It's said to be very simple and may be the answer to the long-standing problem of moving automatic welding from the plant into the field.

The electric motor, principal driver on oil pipelines, now is becoming attractive on a few gas lines for centrifugal booster stations.

El Paso Natural is building its first two electric stations in northern Arizona on its line to California.

Trans-Canada Pipe Lines plans several electric stations in Ontario.

Texas Eastern, the industry's largest electric-power user,

also is building more stations with this type of drive. Its 20,000-hp. giant at Egypt, Miss., will be biggest electric motor on any pipeline.

▼ ▼ ▼

Military buying will give oil a boost next year.

Needs for the military are estimated by the Pentagon at 743,000 bbl. of products daily starting next July 1. That's a 22% gain over present tempo of buying.

Two events could sharply change this estimate up or down: A shooting war or an economy wave.

With their needs on the rise, military leaders have two concerns: Ability of industry to turn out low-freeze kerosine and diminishing gains in refining capacity (p. 103).

California Research Corp. is using a conventional gas-chromatographic analyzer to find how crank-case oil is diluted by gasoline.

Method has good precision, accuracy, and sensitivity. Test is simple and inexpensive.

Samples as small as one-fourth of a milliliter may be run. And it's possible to identify individual gasoline-fuel components which appear as diluent in the oil.

Venezuelan refiners are looking to local markets.

Socony Mobil will have 20 service stations in Caracas area when its El Palito refinery opens next year. Texaco has opened six stations in eastern Venezuela and has three more under construction. Phillips has started selling Venezuela's first locally-made dairy wax.

Texaco plans a major expansion of its refinery at Pointe-a-Pierre, Trinidad.

The 100,000-bbl. daily capacity of the refinery may be doubled, making it one of the Caribbean's refining giants.

It's all still in the planning stage and no timetable for the project has yet been set.

▼ ▼ ▼

Gasoline prices have dropped again on the Gulf Coast.

Quite a bit of price shading went on last week. But now the weakness is out in the open. Quotations are down 0.25 cents a gallon on all grades.

New prices:

Regular grade, 92 octane, now 10.25 cents a gallon in cargo lots. It was 11 cents early in July and 11.25 cents at this time last year.

Premium, 98 octane, is 11.75 cents compared with 13 cents on October 1 last year.

Wyoming has some good exploration news.

Atlantic Refining-Fremont Petroleum's 3 O'Brien Springs Unit may be state's most important discovery of year.

Well gaged flow of 492 bbl. of 43°-gravity oil daily from Tensleep at 6,965-7,002-ft. Gas also flowed on test at 5,384-5,443 ft. at rate of 2,500 M.c.f. daily.

Location is at east end of Red Desert basin in an area of little previous Tensleep production. The Tensleep is one of Wyoming's most important pay sands.

First private concession under Morocco's new oil law will go to Ambassador Oil of Fort Worth. Same company is sharing in a new concession in Ireland.

Reports from Rabat indicate Ambassador has sewed up a 50-50 concession deal covering up to 18-million acres in Morocco's petroleum Zone II. This is north, northeast, and east of the 30,000-sq.-km. area handed a new company formed by Italy's government-backed E.N.I. and Moroccoan Government.

Geologists are revising some of their theories in wake of data turned up by Phillips' 25,000-ft. well in West Texas.

Previous theory was that the Ellenburger could be reached in center of Delaware basin with 25,000-ft. well. But it took Phillips 24,974 ft. to find this formation at its test in the Sheffield Channel, an ancient seaway connecting the Delaware and Midland-Val Verde basins.

The Phillips well indicates a much greater depth will now be required to hit the Ellenburger in Delaware basin (p. 237).

▼ ▼ ▼

Good gains in 1959 are seen for drillers, producers.

Journal economist tells AAODC in Dallas to expect:

...7,300,000 bbl. daily crude production in first quarter and stepping up sharply rest of year to new record.

...54,000 to 56,000 wells needed during the year.

...for long range, 11,750,000 bbl. daily production by 1965 and 75,000 wells yearly.

The controlling factor, however, is average realization by refiner for the products he makes from a barrel of crude.

Here's the cycle: If refiner's profit margin drops, he must find way to cut costs. Crude is his biggest expense item. If he can't cut other costs, he must buy cheaper crude. Cut in crude price hurts producers, makes them reduce number of wells drilled. This means some contractors will have to stack rigs (p. 110).

▼ ▼ ▼

August imports exceeded the government quotas.

Volume was 977,400 bbl. daily or 43,300 bbl. daily over allocations. Biggest gains were in Districts 1-4 (p. 108).

The Oil and Gas Journal is published weekly by The Petroleum Publishing Co., 211 S. Cheyenne, Tulsa 3, Okla. Second-class postage paid at Tulsa, Okla. United States and foreign rates to the petroleum industry, 1 year $5, 2 years $8, 3 years $10.

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IN THE NEWS

General Interest:

Armed Forces, Oil's Best Customer, to Step Up Buying 103
New Supreme Court Session Faces Weighty Oil Docket 107
Pauley Combines Holdings in Newly Formed Corporation 107
Journal Editors Outline Oil's Future at AAODC 110
Congress Will Study Privately-Owned Atomic Tankers 117
Atlantic Staffs University Lecture Series 118
West Coast Shipyards Ready to Build Offshore Platforms 119

Processing:

New Petrochem Plant Goes on Stream in Louisiana 106
August Crude Imports Spurt Above Allocations 108
Low Distillate Stocks Still Don't Mean a Shortage 114
Oversupply Forces Price Cut in California Heavy Crude 116
Processing Briefs 120

Foreign:

New Aramco Barge Drills Stepout to Manifa Discovery 122
Libyan Wildcat Has First Show and Is Going Deeper 122
First Test Spudded in Burma's Irrawaddy Delta Region 122
Texas Independent Lands Three Moroccan Concessions 123
Creole Building Five Giant Storage Tanks at La Salina 123
Independents Wrapping Up Concession Covering Ireland 124
Mexico Starts Work on Biggest Pipeline Project 124
Rimrock's Partner Steps Out of Paraguayan Deal 124

Pipelining:

Rate Cases Pending Before FPC Total $211.5 Million 117
Pipeline Briefs 118
FPC Speeds Up Midwest Gas Case 120

Drilling-Production:

Three New Blowout-Control Devices Ready for Action 112
Amerada to Start Injection at Tioga, Beaver Lodge 115
Free-World Production Rises for Second Month 121

Exploration:

What West Texas Deep Drilling Has Shown 287
50-Year-Old Prediction Holds True, Unfortunately 288
September Exploration Achievements and What's Ahead 292

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SPECIAL DATA-LOGGING SECTION

Draw Works and Compounding Transmission **125**

By Ed McGhee

A special 16-page report which tells how to get your money's worth from your draw works, compounding transmission, chains, drum brakes, auxiliary brakes, clutches, V-belts, and bearings. This report tells what to look for when buying a new rig and how to treat it to keep equipment trouble-free.

Five Factors That Affect a Drilling Rate **141**

By Preston L. Moore

What are the steps one must take to get optimum conditions in a drilling operation? The author of this special section says: (1) Correct mud properties to give maximum drilling rate, (2) select optimum bit weight and rotary speed, as detailed in this report, (3) maximize bit horsepower by selection of optimum circulating rate, and (4) check surface horsepower to see whether it is at the maximum range.

Active Fields Report Drilling Data **172**

By Norman S. Morrisey

Data on geology, drilling, and completion practices in active fields plus for the first time reliable information on actual costs of flowing and pumping wells and dry holes. The survey covers fields in both United States and Canada.

TECHNOLOGY—OPERATION

Nelson Refinery Construction Index **216**

Costimating **217**

Process Costimating, No. 28 **218**

Two New Recovery Processes **220**

By Norman J. Clark

Miscible drive and combustion drive are two promising new recovery methods presently being tested both in the laboratory and in the field. This Core Laboratories, Inc., author reviews the basic principles involved and gives some points from management viewpoint concerning exploitation of oil reservoirs to obtain the greatest efficiency in oil recovery.

Sinclair's Corpus Christi HF Alkylation Unit **224**

By Larry Resen

Low isobutane-olefin ratios, low acid consumption, high-quality alkylate, and high efficiency characterize the HF alky unit operation at Sinclair's Corpus Christi, Tex., refinery. Defluorination is so effective that the secondary bauxite towers are bypassed and only one of the two primary bauxite towers is required. Presently propylene constitutes 31% of the olefin feed.

On the Job . . . Pipelining: Simple Analog Computer Finds Line Pack **229**

DEPARTMENTS

They Say	93	Costimating . . . Cost Index	217	Personals	318
Calendar of Events	94	Process Costimating	218	Statistical Summary	322
Journally Speaking	97	On the Job . . . Pipelining	229	Drilling Statistics	323
Editorial	99	Drilling Contractors	235	Supply Statistics	324
Watching Washington	109	New Equipment	268	Refining Statistics	325
Foreign News	121	Trade Literature	275	Markets	326
Refinery Construction Index	216	Equipment Men in the News	278	Classified Advertising	327
Book Review	216	Exploration Highlights	287	Advertisers' Index	331

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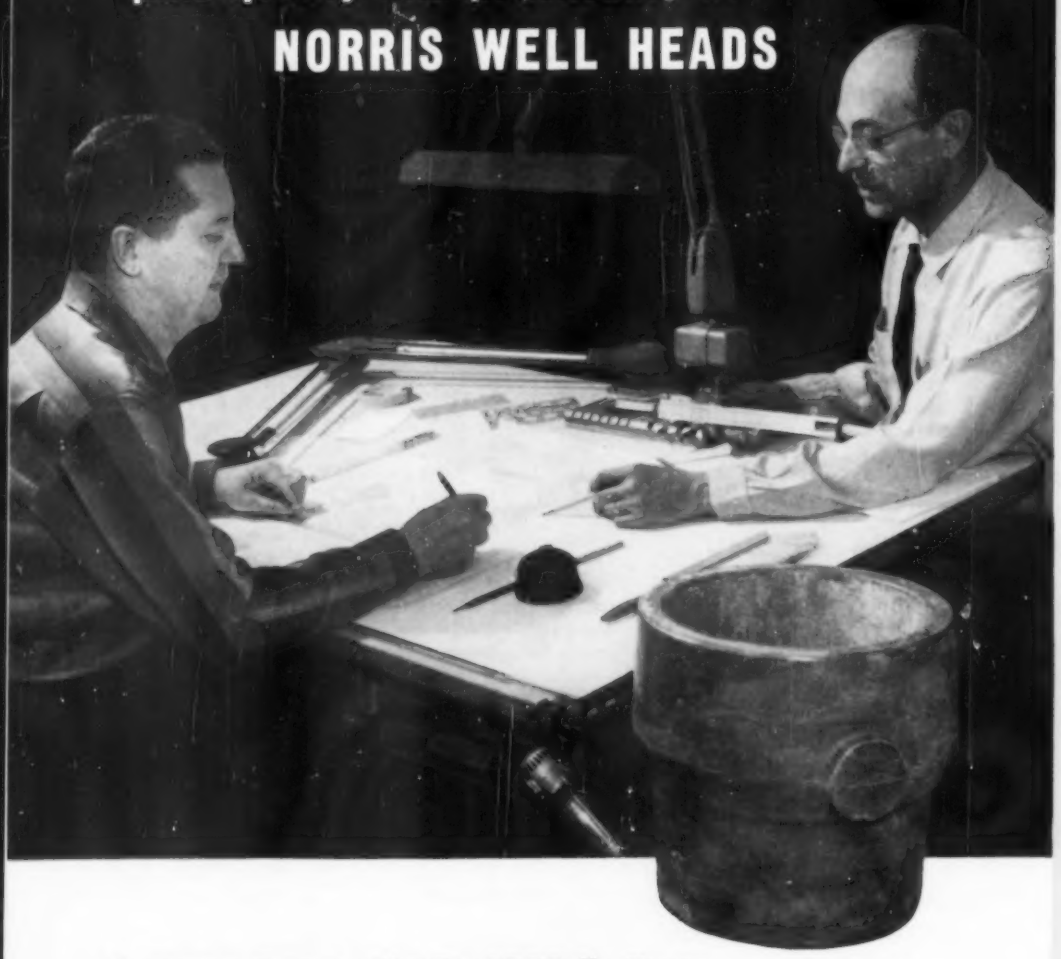

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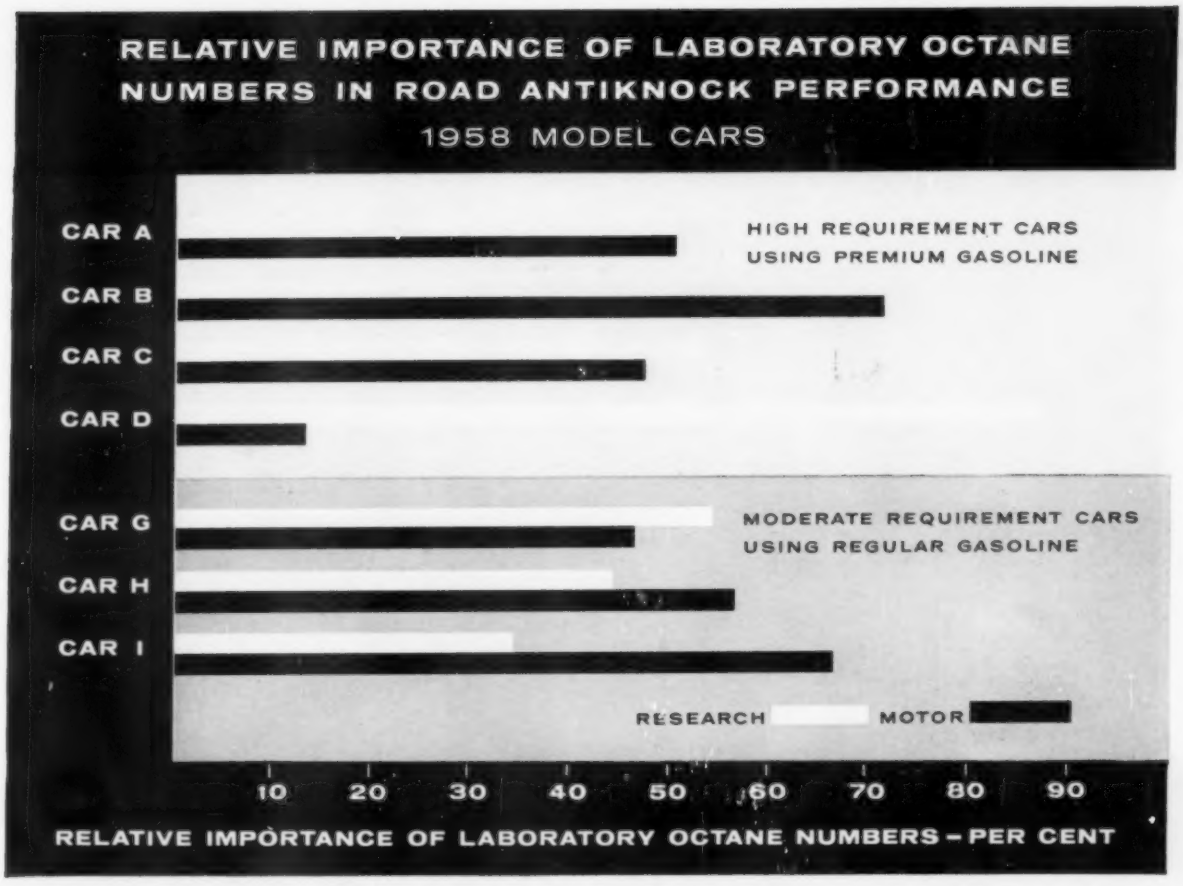

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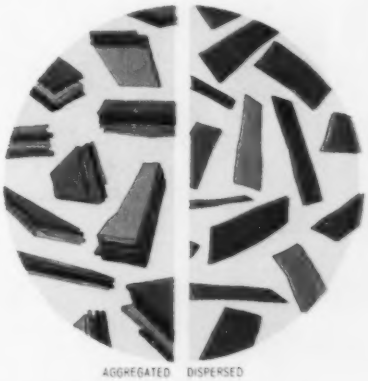

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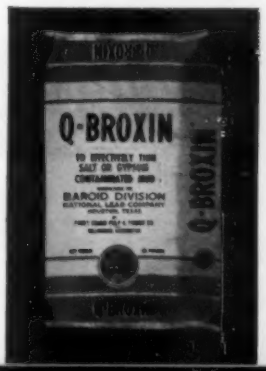

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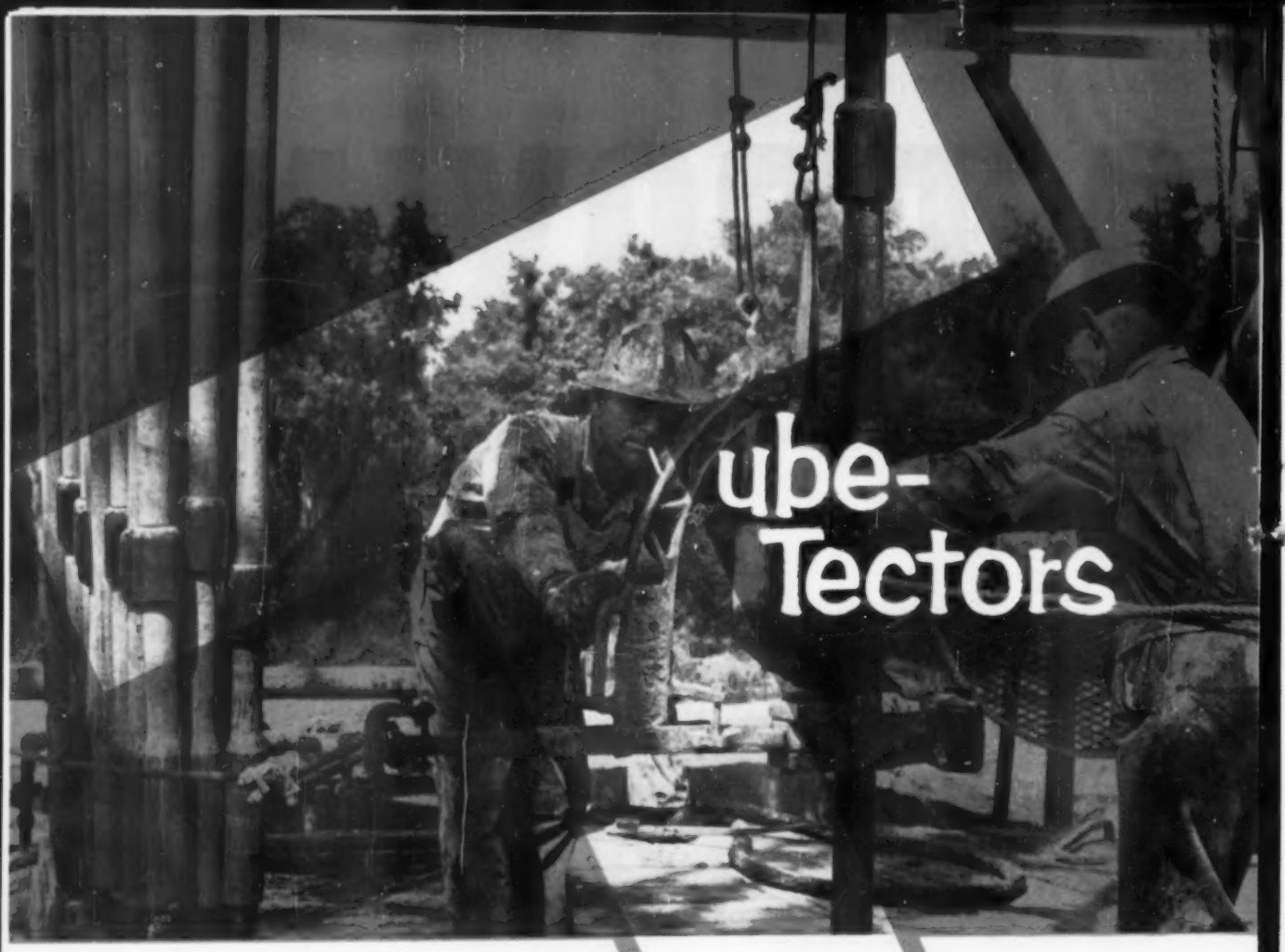

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Timken-Detroit "3 for 1" Axles Are First Choice With Big Fleet Operators!

These superior features make the difference:

Interchangeability of Three Final Drives. Single-Speed Single-Reduction, Single-Speed Double-Reduction or Two-Speed Double-Reduction final drives using the same housing, hubs, drums, brakes and axle shafts gives your vehicles unmatched flexibility. Parts are readily available and less expensive.

Hypoid Gears. Larger pinions and greater tooth contact give 30% more torque capacity, top efficiency and long life . . . plus lower maintenance costs.

True Double Reduction. Two full size gear sets, one for each reduction, provide huskier gears and a balanced distribution of effort. Gears and bearings last longer and need less maintenance.

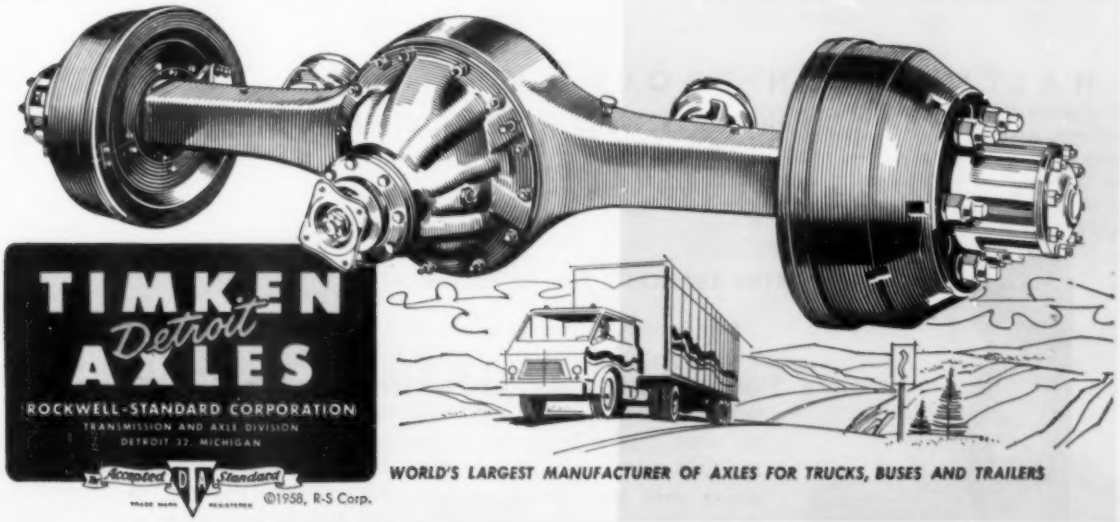
Torsion Flow Axle Shafts. More splines, plus greater root and body diameter, add extra strength.

Famous Time-proved Differential. Extra-strong gear body and teeth, plus hot-forged trunnion, give long trouble-free operation even under the roughest kind of treatment.

Hot-Forged Steel Axle Housing. The rectangular form of these high carbon steel housings is the lightest, strongest shape of housing that is available today.

PROVED AND PREFERRED...

Timken-Detroit® Axles are the Accepted Standard!



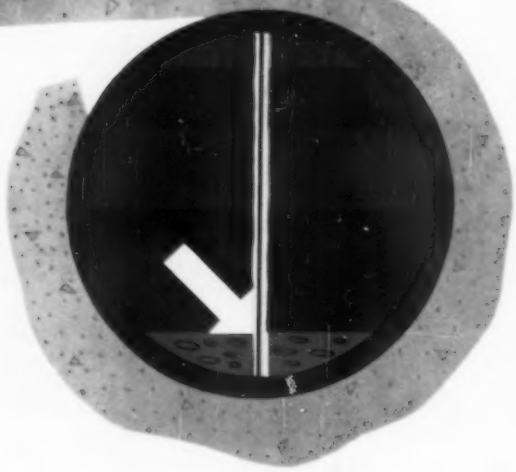
WORLD'S LARGEST MANUFACTURER OF AXLES FOR TRUCKS, BUSES AND TRAILERS

Products of **ROCKWELL-STANDARD** Corporation

"PAY-ZONE" PROTECTION

PRIMARY CEMENTING...

by HALLIBURTON



The primary cementing job is the most important factor influencing the "pay-out" of your well when a promising pay-zone is realized.

For dependable well-life for years ahead... *primary cementing* by Halliburton gives you more advantages and protection for a long-term profitable operation.

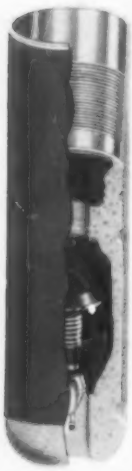
HERE'S HOW OPERATORS ADD UP THE ADVANTAGES OF HALLIBURTON PRIMARY CEMENTING:

- For protection and conservation of possible oil producing zones
- For protection against the migration of water, oil or gas from one formation to another
- For protecting casing from corrosive fluids
- For reducing the danger of contamination
- For aid in controlling high or low pressure zones

It will pay to look into these advantages further – whether it's today or tomorrow – when you're ready for successful primary cementing... you're ready for Halliburton!

HALLIBURTON TOOLS:

PRIMARY FACTOR IN SUCCESSFUL CEMENTING



HALLIBURTON AUTOMATIC FILL-UP EQUIPMENT

Simple design, operational ease and greater economy are features of Halliburton Automatic Fill-Up Float Collars and Float Shoes. These precision tools save running-in time of casing; minimize damaging pressure surges; convert to Super Seal Floating when tripped by moderate increase of circulating pressure and fluid volume using a conventional rig pump. These double-action units have orifice metering that measure the flow of drilling fluids while running casing. The durable nose guide of high strength concrete helps guide casing easily to bottom.

HALLIBURTON
TURBO-JET GUIDE SHOE

Guides casing to bottom with ease, greater economy and safety. Turbo-jetting is the most *effective* scouring action on the mud-cake, cleaning the bottom hole wall for a tighter, better sealed primary cementing job. Jet-stream of fluid is forced by built-in rotor through sideports and guide nose to agitate cement for uniform cementing around casing.

HALLIBURTON ROTO WALL CLEANER

By comparison the most effective and efficient mud-cake remover in the field. The horizontal rotating action of this tool decreases lost circulation problems as mud-cake is undisturbed through porous formations while running. Stronger, tighter and more enduring results in primary cementing are attained to help form a more durable bond between cement and bore wall, greatly reducing remedial jobs.

HALLIBURTON
SOLID SET SCREW LIMIT RING

A new limiting device with superior locking power handles heavy loads (to 14,000 lbs.) when positioning auxiliary casing equipment. Limits movement of accessory equipment without welding.

HALLIBURTON
VISE-LOK LIMIT CLAMP

Another new device, with even greater locking force than the Solid Set Screw Limit Ring – for the installation of Recipo Cleaners, Casing Centralizers and Cement Baskets on casing. Protects against vertical movement with greater load-carrying capacity. Special file hard gripping discs, inside the steel ring, are forced against the casing by taper pins driven in from behind. Hinged for easy installation, completely eliminates welding of lugs or limiting devices.

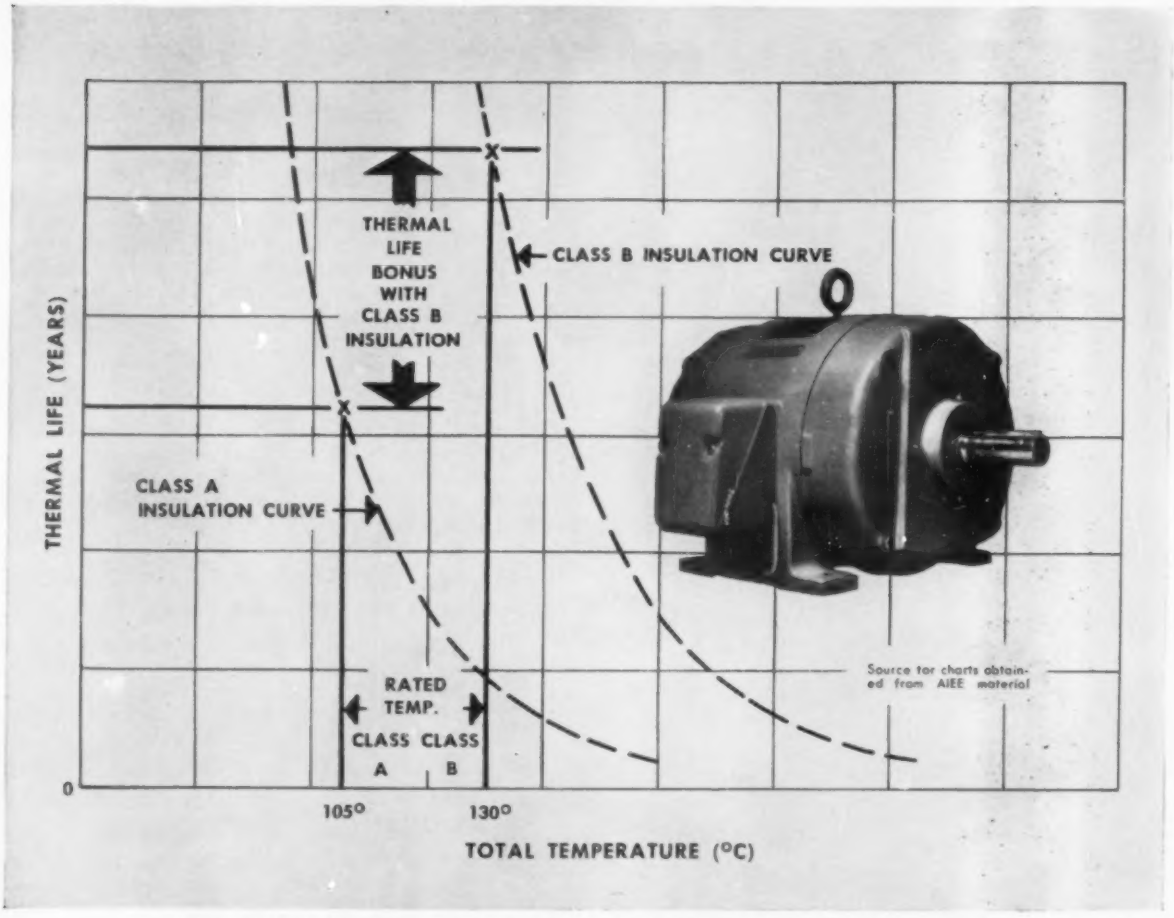
HALLIBURTON CEMENT BASKET

Successfully used in primary cementing to help protect weak formations and retain cement by reducing slurry loss and breakdown of porous formations. Run outside of the casing or liner above defective formations, the basket acts as a support after cement is pumped and "bridges" heavy cement columns until initial set.

HALLIBURTON CEMENTING SERVICES

HALLIBURTON OIL WELL CEMENTING COMPANY • DUNCAN, OKLAHOMA

284 SERVICE CENTERS – THE BEST CEMENTING IN THE OIL-FIELD



LIFE-EXPECTANCY CHART shows relative life spans of insulations. With motors operating at rated temperatures, Class B insulation gives 70% longer winding life than Class A-insulated windings.

GENERAL ELECTRIC OIL FIELD MOTORS, WITH ALKENEX* CLASS B INSULATION, OFFER . . .

70% Longer Winding Life

Recent laboratory tests—confirmed by actual field experience—have demonstrated that General Electric Oil Field Motors—with Alkenex Class B insulation—give far greater winding protection than motors having Class A insulation.

As indicated by the life-expectancy chart, windings of Class B-insulated motors will last up to 70% longer than Class A-insulated windings if both motors are operated at rated temperatures. And, since G-E oil field motors are designed to operate within actual nameplate ratings, this extra service life can be fully realized.

Even in the case of inadvertent overloading, the Alkenex Class B-insulated motors will stay on the line longer at temperatures that would burn out Class A insulations.

LONGER BEARING LIFE—To achieve longer bearing and grease life, the Tri-Clad* '55' motor provides an extra-large grease reservoir and a specially-engineered double-end ventilation system.

The grease reservoir actually holds up to five times more grease than is possible in sealed-bearing systems. And the ventilation system pulls cool air in over *both* bearing housings, so that bearing and grease temperatures are only a fraction of motor temperatures.

By utilizing these insulation, bearing, and cooling systems, G-E engineers have achieved major reductions in motor size, while actually improving performance and dependability.

PROOF IN APPLICATION—Since the General Electric Alkenex Oil Field Motor was introduced in 1956, thousands have been installed in oil fields throughout the U.S. and Canada. During this period, the performance record of these motors has been outstanding. Even the 1957 Texas floods put only a small number out of service.

This remarkable record can pay important dividends in *your* oil field pumping operation. Longer motor life, with fewer breakdowns can mean larger profits from wells. For more information on the reliable G-E Alkenex Oil Field Motor, contact your nearby General Electric distributor or Apparatus Sales Office. General Electric Co., Schenectady, New York.

*Reg. trademark, General Electric Co. 599-2

GENERAL ELECTRIC

"POWERSTEEL"

WIRE ROPE

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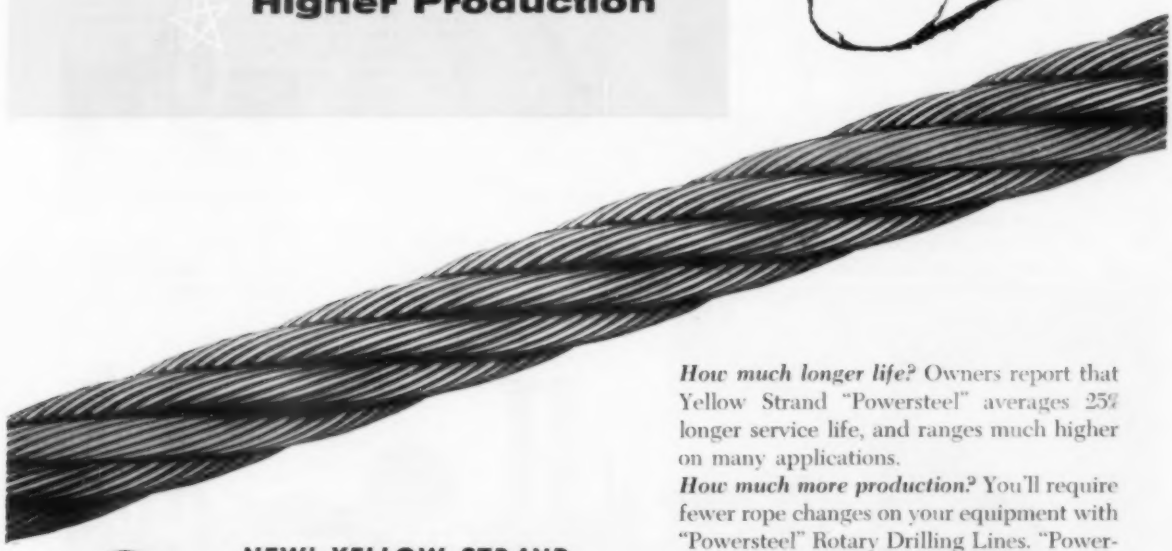
Longer Life

Higher Production



NEW! YELLOW STRAND WIRE ROPE CLIPS...

Ask for them at your Yellow Strand Wire Rope Distributor. Heavy-duty galvanized steel U-bolt. Drop-forged steel saddle, hot dip galvanized. Easily applied.

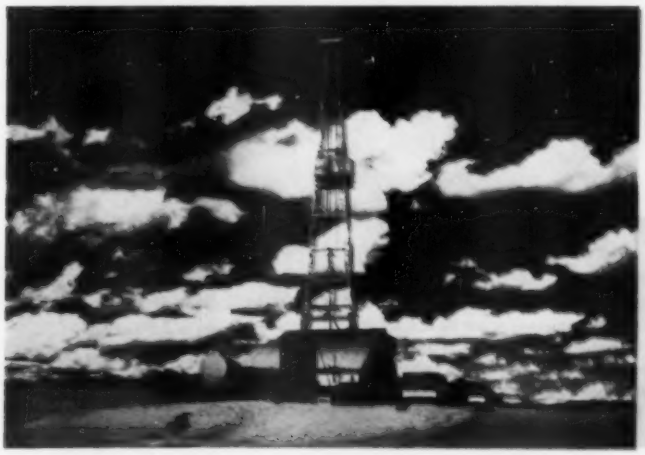
How much longer life? Owners report that Yellow Strand "Powersteel" averages 25% longer service life, and ranges much higher on many applications.

How much more production? You'll require fewer rope changes on your equipment with "Powersteel" Rotary Drilling Lines. "Powersteel" gives you greatly increased ton-mile-per-foot service . . . greater safety.

"Powersteel" Rotary Line is extra high-strength for heavy loads and deep well drilling. It spools freely, resists wear and crushing, and was developed for your high speed, high production equipment.

Your nearby Broderick & Bascom Distributor stocks an ample supply of Yellow Strand "Powersteel." See him for complete details. Broderick & Bascom Rope Co., 4203 Union Boulevard, St. Louis 15, Mo.

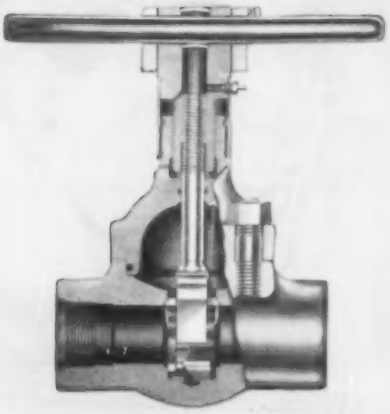
Stocked by Continental-Emsco Company throughout Mid-Continent and Rocky Mountain fields.



Yellow Strand®

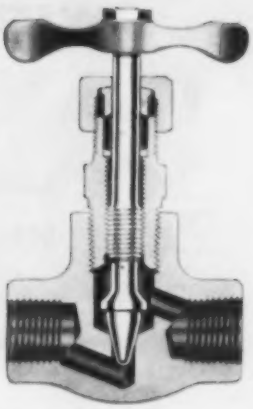
Quality WIRE ROPE since 1876

Rockwell-Built Edward Steel

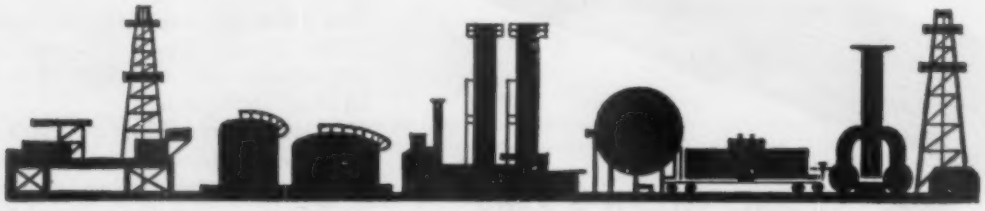


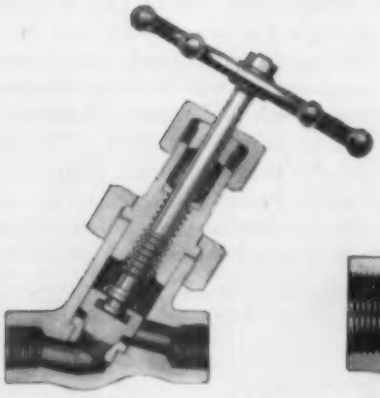
MUDWONDER MUDLINE VALVES
Figs. 2128-3128
For pressures to 2,000-3,000 lb WOG
Bolted bonnets, screwed or flanged ends

GLOBE STOP VALVE
Fig. 158
For pressures to 10,000 lb WOG
Screwed bonnet, screwed or socket welding ends

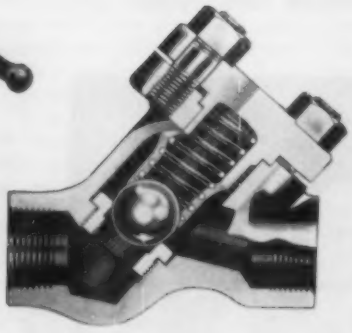


GLOBE GAGE VALVE
Fig. 152
For pressures to 4,000 lb WOG
Screwed or union bonnet, screwed ends

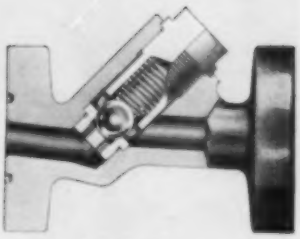




GLOBE STOP VALVE
Fig. 2698
For pressures to 2,000 lb WOG
Union bonnet, screwed or socket welding ends



BALL CHECK VALVE
Fig. 4632
For steam pressures to 600 lb A.S.A. (2,000 lb WOG)
Horizontal or vertical
Bolted cover, screwed or socket welding ends



BALL CHECK VALVES
Figs. 5160-9160
For pressures to 5,000-10,000 lb WOG
Horizontal or vertical, screwed covers, flanged ends

Valves Work Everywhere

in drilling... production... refining...

Edward valves are on the job, no matter where you look. From the towering derricks of Northern Alberta to offshore rigs on the Gulf . . . from refineries on the Jersey Flats to California natural gas plants . . . the word is—"You buy a better valve from Edward!"

Edward Globe Valves

Bodies are drop-forged steel, for greater strength and resistance to erosion. Large-diameter handwheels permit operation without a wrench or cheater; cross-arm Impactor* handle for quick, tight closing is standard on 2" Fig. 158. Figures 158 and 2698 have replaceable seats. Disks—both plug and needle types—are carefully aligned, and seats are lapped for tight sealing. Stems are EValloy,* an exclusive Edward stainless steel, centerless ground to a fine finish. Carefully machined Acme stem threads assure easy operation. Bonnet threads plated by an exclusive EValizing* process for maximum resistance to wear and corrosion. Deep stuffing boxes, with exclusive EValpak* asbestos-graphite packing, assure a tight seal with minimum resistance to stem turning.

Edward Ball Check Valves

Identical to Edward globe stop valves in body and seat features. Rolled steel bonnet with integral ribs to guide ball accurately. Ball is corrosion-resistant high carbon stainless steel, precision-ground for tight seating. High carbon stainless steel spring gives positive aid in seating ball.

Edward Mudwonder Valves

Body and bonnet are high-strength alloy steel with heavy body-bonnet cover flanges. Accurately machined to assure drop-tight sealing under extreme pressures. Double-threaded yoke bushing, completely enclosed, gives 2-to-1 ratio. Corrosion-resistant stainless steel stem with slotted gate coupling to eliminate bending or binding. Gate is hard chrome plated to reduce friction, resist erosion and abrasion. Seat insert of resilient buna-N synthetic rubber, molded integrally over steel wear rings. Seat and gate easily replaced without removing Mudwonder* from line.

WHERE CAN YOU USE EDWARD VALVES?

Our customers report complete satisfaction in the use of Edward valves for water flood service . . . throttling . . . on high-pressure heaters, treaters and separators . . . on pressure vessel controls . . . on headers and flow lines to heaters and exchangers . . . for manifold service . . . in gasoline or gas sulfur extraction plants . . . for "unloading" valves at gas compressor stations . . . and in many other applications. You name your need . . . let your Edward representative show how to fulfill it with versatile, economical, completely dependable Edward valves. They are available from your favorite oil field supply store, from your industrial distributor, or direct from *Edward Valves, Inc., 1200 W. 145th Street, East Chicago, Indiana* (Subsidiary of Rockwell Manufacturing Company). Represented in Canada by Lytle Engineering Specialties, Ltd., Montreal, and Rotary Sales & Service, Ltd., Edmonton.

EDWARD STEEL VALVES

another fine product by

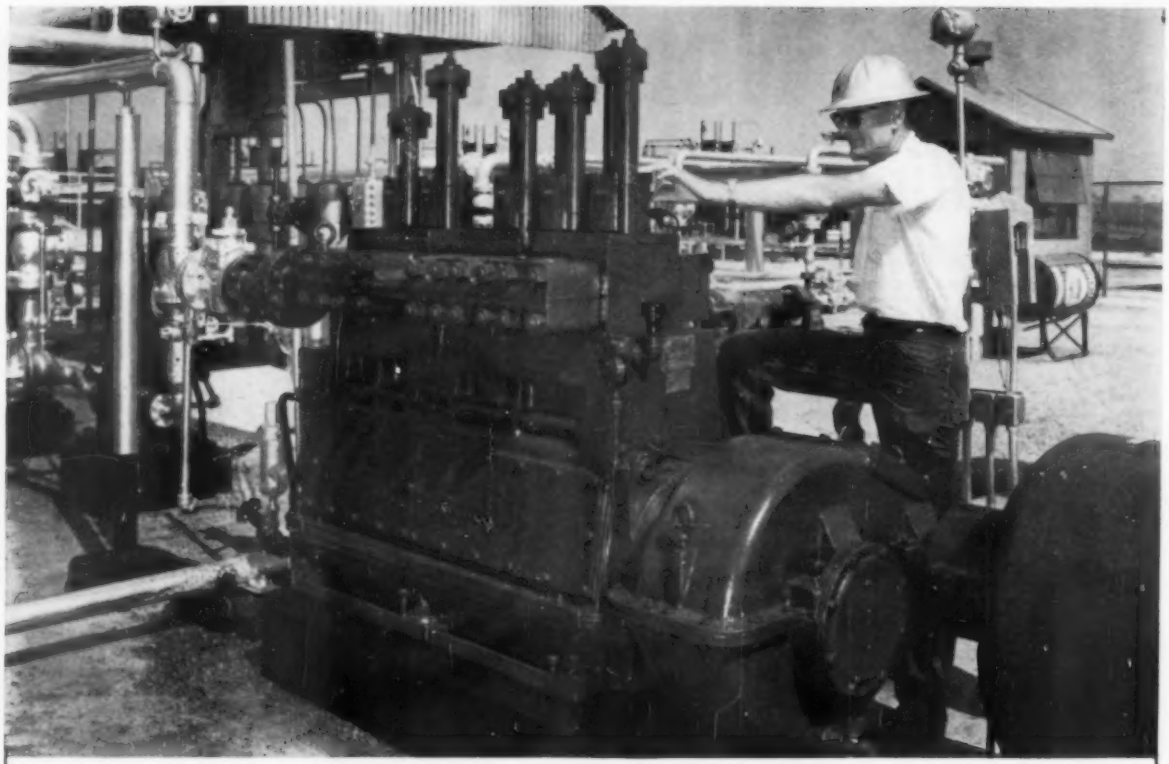
ROCKWELL

Edward builds a complete line of forged and cast steel valves from ¼" to 18"; in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, instrument, gage and special designs; for pressures up to 10,000 lbs; with pressure-seal, bolted, union or welded bonnets; with screwed, welding or flanged ends. *T.M. Reg. U.S. Pat. Off.

Edward 2" Fig. 158 valves in service on heater by-pass lines in Louisiana oil fields. Note Impactor handles for quick, easy closing against high pressures.

Fig. 2698 valves on cooling coils of natural gas cooler. Scene: New Mexico field processing plant. Lubricated plug valves in photo are Rockwell-Nordstrom.

Forty-two Edward forged steel globe valves (Fig. 2698) throttle the flow on this West Texas water flood. Owner reports absolutely no maintenance costs in two years (over 4,000,000 barrels of water)!



FIELD REPORT

SERVICE: LP-Gas Injection
Burnell—North Pettus Cycling Plant

PUMP: 1½"x5" Aldrich Quintuplex

OPERATION STARTED: June, 1950

EXPERIENCE TO DATE:

Continuous service...pump delivers 52 gpm at 3000 psi. Routine maintenance annually...plungers are repacked as necessary. Customer reports: "complete satisfaction" with the performance of the Aldrich pump.

Field parts stock available in Carmi, Ill.; Calgary; Casper, Wyoming; Charleston, W. Va.; Houston; Los Angeles; Odessa and Tulsa. For further information, write the Aldrich Pump Company, 3 Gordon Street, Allentown, Pa.

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These Mathieson organics will meet your most exacting requirements. They are produced to uncompromising quality standards at our modern organic chemicals plant in Brandenburg, Kentucky. Terminal storage facilities are maintained at: Houston, Odessa and Borger, Texas; Abbeville, Louisiana; Farmington, New Mexico; St. Louis, Missouri; Chicago, Illinois; as well as at the Doe Run plant in Brandenburg.

Bulk and drum shipments are quickly made from any of these points. Contact our sales office nearest you for information and technical data.

Ethylene Oxide	Ethanolamines
Ethylene Glycol	Ethylene Diamine
Diethylene Glycol	Polyamines
Triethylene Glycol	Surfactants (Poly-Tergents)
Polyethylene Glycols (Poly-G's)	Ethylene Dichloride
Glycol Ether Solvents (Poly-Solv's)	Dichloroethylether

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C. E. Williams, Gulf Sales Engineer, Midland, Texas, and G. W. Ramsey, Assistant Plant Superintendent, inspect force feed lubricators on one of the modern gas engines at the Goldsmith plant of El Paso Natural Gas Company.

No lubrication problems in 8 years of operation

Since 1949, twenty-seven gas engine-compressor units developing 39,985 horsepower at the Goldsmith plant of El Paso Natural Gas Company have been thriving on Gulf Security Oil. Bearing, ring and cylinder wear maintenance records have been excellent.

Insure safe, more effective lubrication protection for *your* compressor units. Specify Gulf Security . . . the high quality, straight mineral oil. For full information, call your nearest Gulf office.

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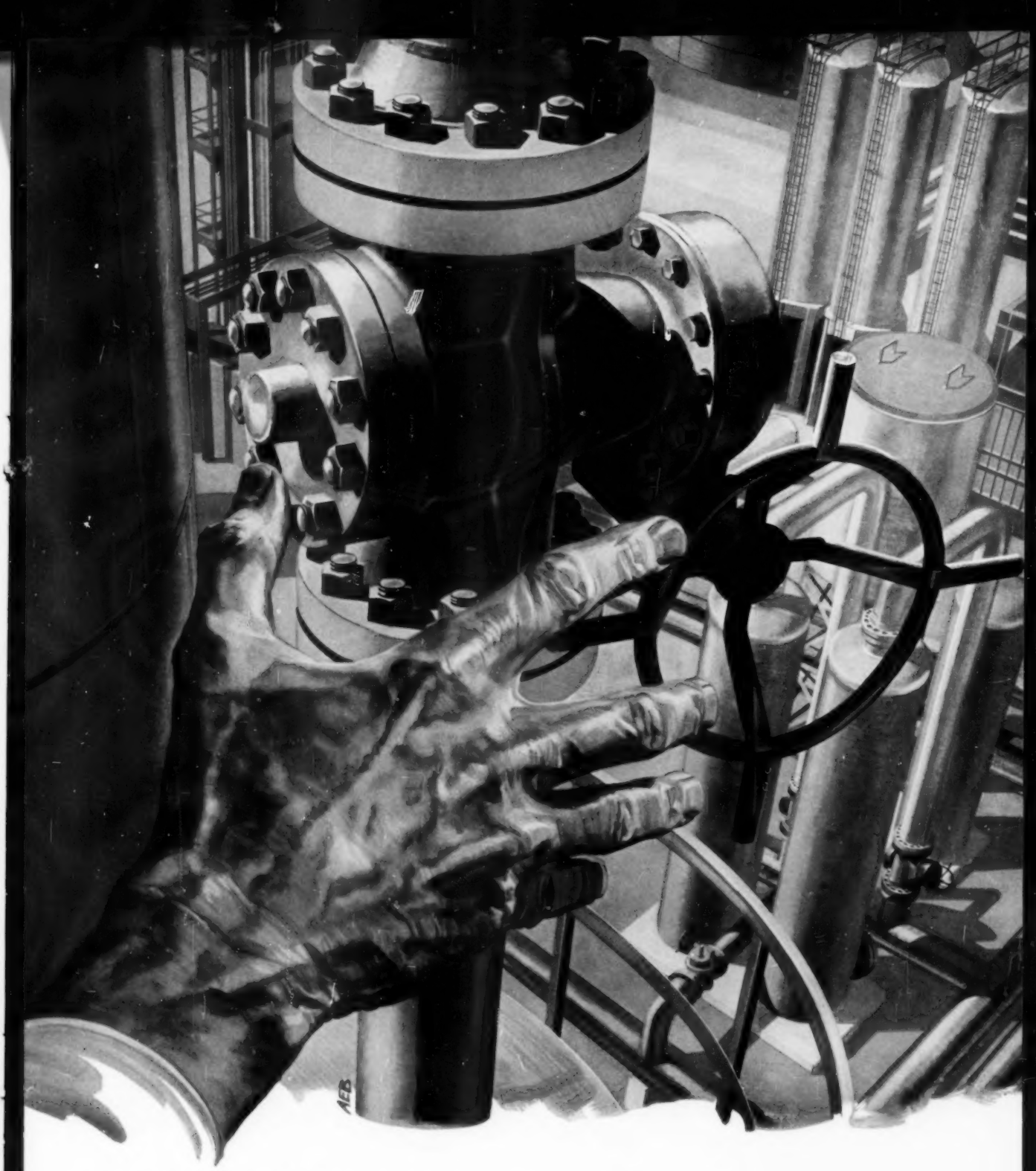


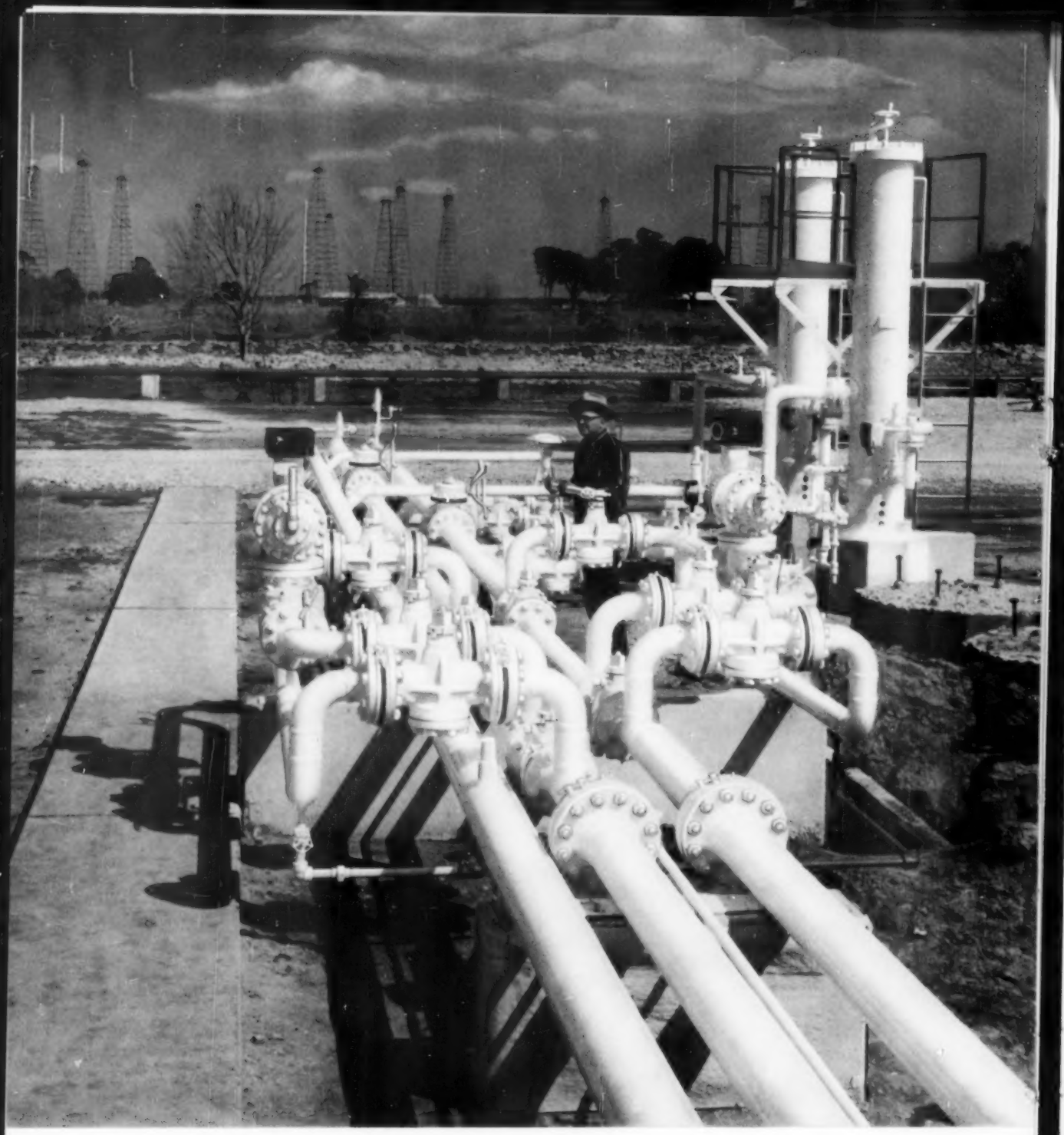
OUT BY ITSELF, this valve is too inaccessible to be pampered if it won't work. It's on services like this that you so often see Rockwell-Nordstrom lubricated plug valves. Why? Pressurized lubricant forms a *leakproof seal*, prevents wear, keeps the quarter-turn operation smooth and easy. Proved on tough services, Rockwell-Nordstrom valves naturally work better, stay in service longer and cost less to use.

Available everywhere in a *complete* range of sizes and pressures. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

ROCKWELL-Nordstrom VALVES

it's ROCKWELL

MANUFACTURING COMPANY



HOW GOOD IS SECOND BEST?

In the oil, gas or process industries, second best is not good enough. That's why you see so many Rockwell-Nordstrom valves where only the *best* is acceptable for critical flow control. Their positive shut-off, easy operation and long-life economy just can't be equaled.

Rockwell-Nordstrom is the world's most complete line of lubricated plug valves and plug valve accessories. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

ROCKWELL-Nordstrom VALVES

it's ROCKWELL

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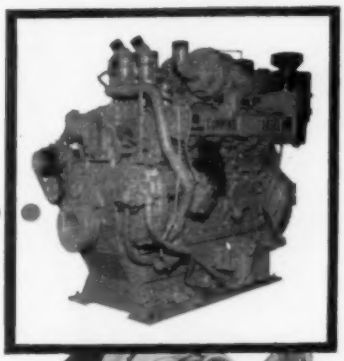
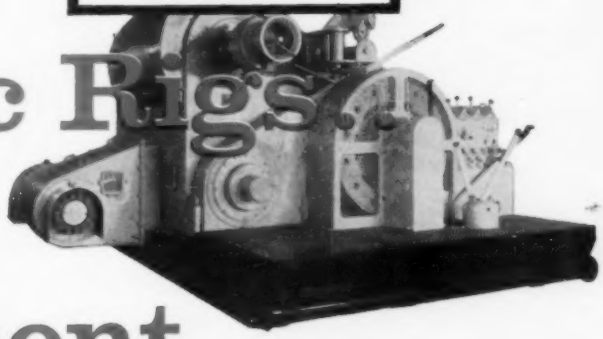
Engines...



Electric Rigs...



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From individual parts to complete rigs, Mid-Continent's experienced engineering personnel can help you select the equipment that meets your specific drilling requirements. And, with thousands of items carried in stock at your local Mid-Continent field store, you can depend on prompt field service... around the clock... from Mid-Continent Supply Company.

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A quality rope is a safe rope

Whether you use wire rope in the field or in a factory, *safety is just as important to you.* When you buy "bargain" rope you bargain with safety. It can cost you more than the pennies you save. Buy on the basis of *quality*—buy Wickwire Rope.

For extra strength—buy Wickwire's Double Gray IWRC extra improved plow steel wire rope

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..... especially agriculture—where product contamination is damaging to crops, toxic to cattle...

Purer Grades Need Improved Processes

..... the *Montecatini* * Processes—which minimize equipment corrosion, virtually eliminate biuret content.

Improved Processes Want Better Plants

..... engineered to get maximum product purity and yield at optimum investment and operating costs...

Better Plants are Built by M. W. Kellogg

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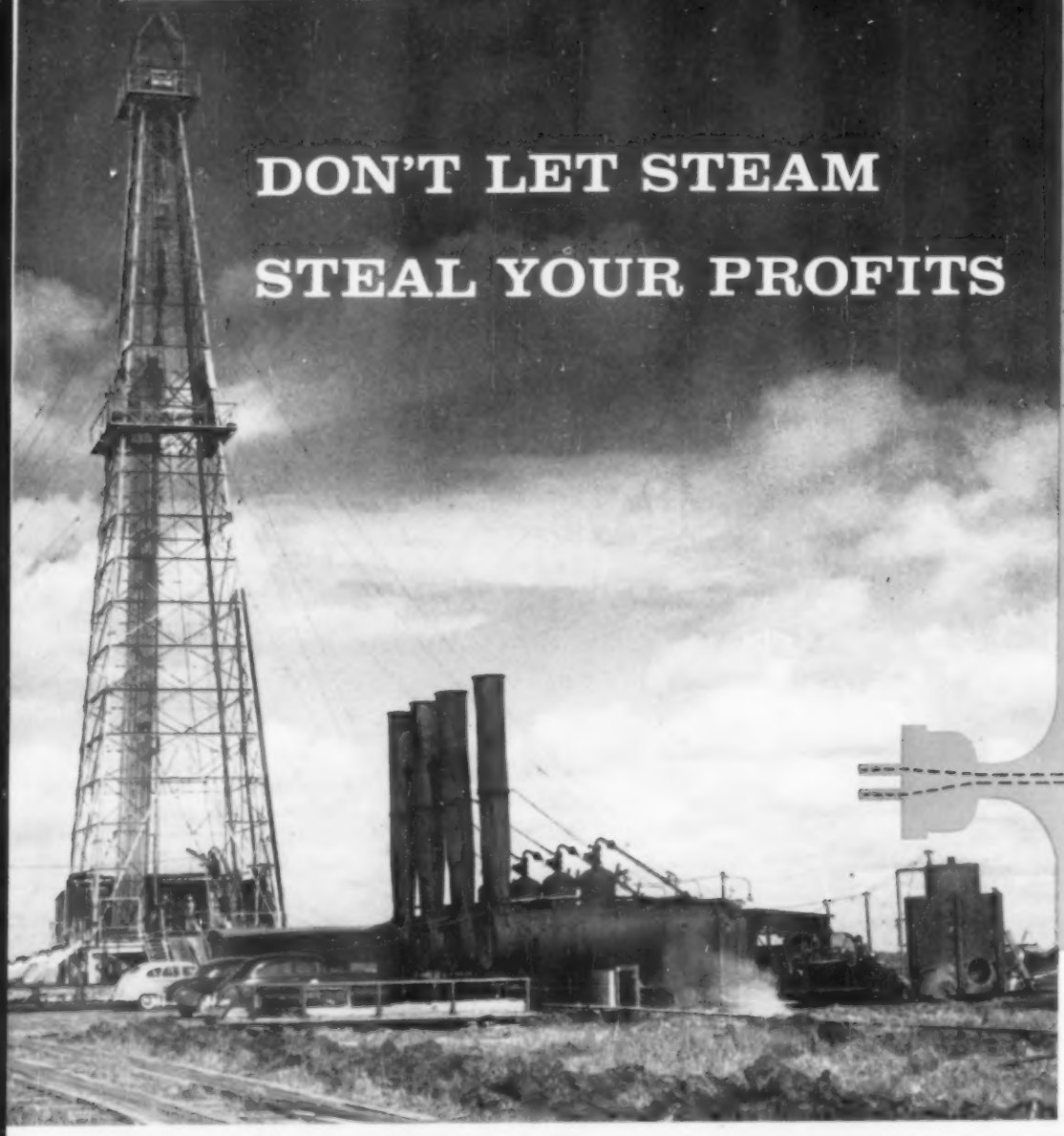
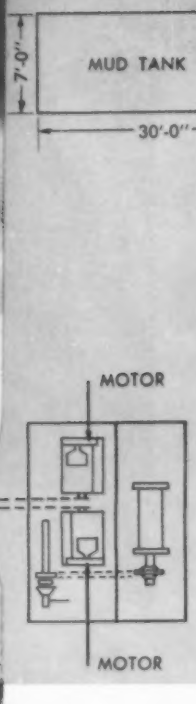
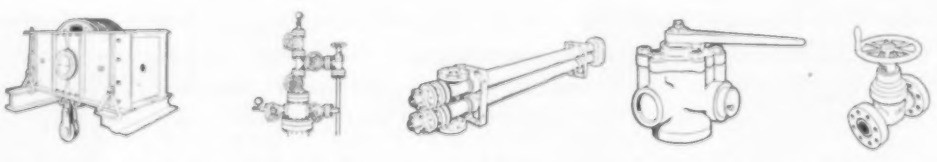
DON'T LET STEAM STEAL YOUR PROFITS

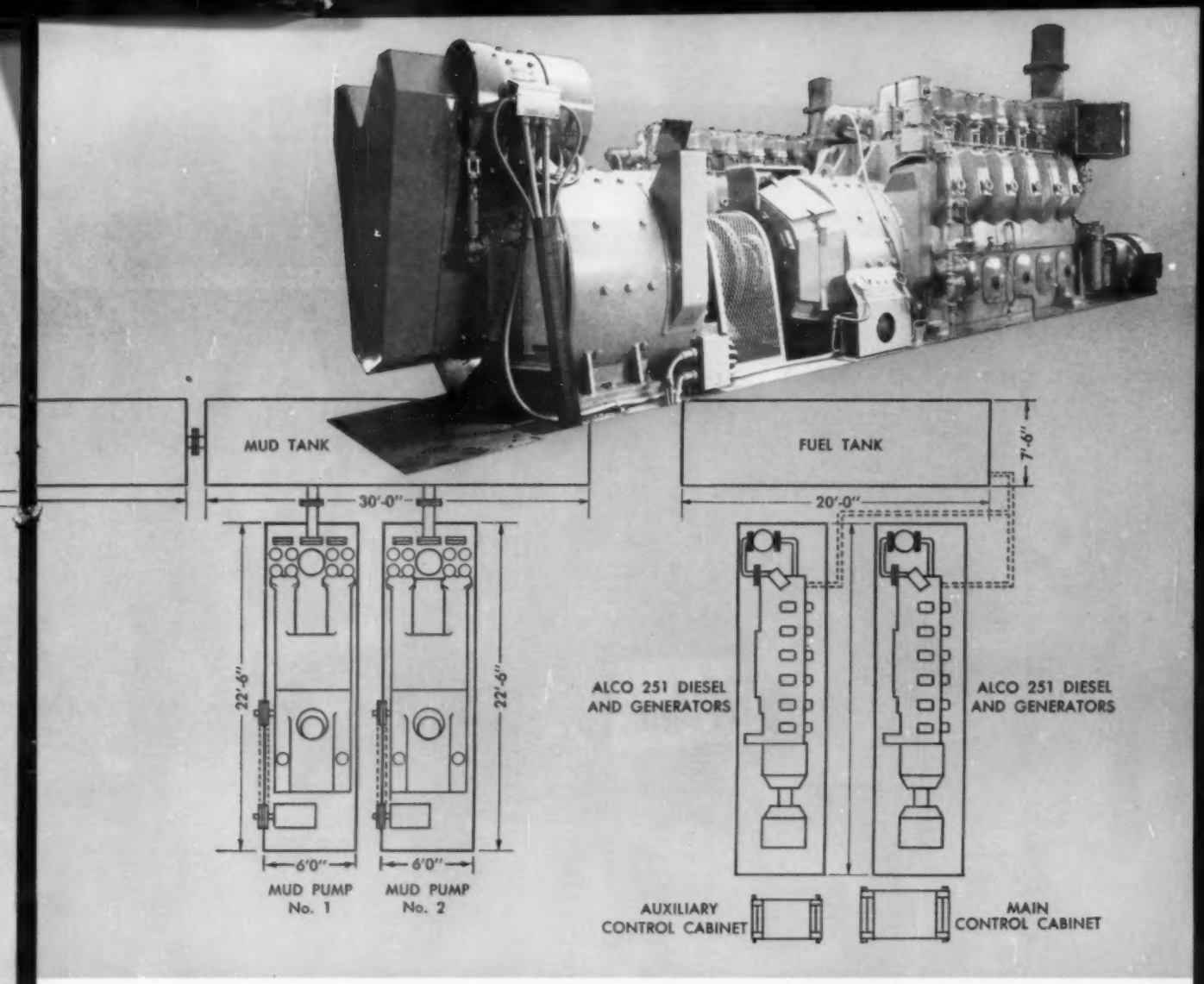




PLUG



Crown and travelling blocks • Wellhead equipment • Finned tube products • Kinney plug injectors • Oil-field valves



IN ALCO DIESEL-ELECTRIC POWER

Put yourself back into competitive bidding—at a better profit—with diesel-electric drilling power by ALCO. Utilizing the famed ALCO 251 diesel, this modern and most economical way to drill will cut your fuel cost, compared to steam power, by as much as 60 per cent. The fuel savings alone in four years can pay for the cost of ALCO power.

You'll save again when moving to new locations, because ALCO power weighs 30 per cent less than steam boilers. You'll realize a further saving through a 10 per cent reduction in rig-up time.

ALCO diesel-electric drilling power is designed, engineered and assembled in Beaumont, Texas, by men who know drilling problems. In three years' field use it has demonstrated its advantages over other comparable diesel power with less fuel consumption, easier maintenance and more efficient electrical operation.

Field engineers trained in the operation and maintenance of ALCO drilling power are located in Houston, Beaumont, New Orleans, and Biloxi. Parts are stocked in Beaumont and Odessa. For complete information on all the savings and advantages of ALCO power, write ALCO Products, Inc., Petroleum Industry Equipment Division, Dept. 187, Bank of the Southwest Building, Houston 2, Texas.

ALCO

ALCO PRODUCTS, INC.
Petroleum Industry Equipment Division
HOUSTON

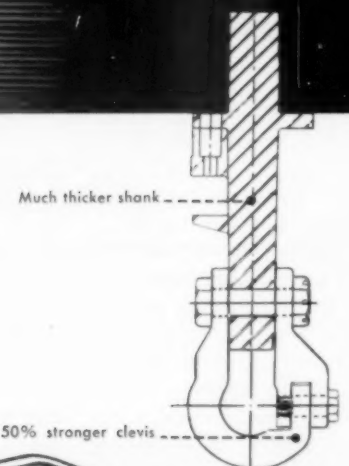
You're looking at the new Wilson...

WORLD'S FASTEST FALLING BLOCK

Only new Wilson Blocks are super fast, super strong and easier to string.

The new Wilson Tubing and Traveling Blocks are the most free falling blocks ever built. They use the same trouble-free sheaves and sheave bearings used in Wilson crown blocks so successfully for many years. With their stronger shank, stronger bolts and clevis, Wilson Blocks are the strongest for their rated capacity on the market. See drawing at right! In addition the "string-up link" can be passed through the block without difficulty when stringing up, which is impossible with other blocks. Write today for complete specifications on Wilson 20" and 24" double and triple blocks.

BE MODERN — BUY WILSON



SECTION THROUGH WILSON HOOK

Wilson

WILSON MANUFACTURING CO., INC.
WICHITA FALLS, TEXAS
THE HOME OF RED IRON

ngineering Progress Report
FROM UNION CARBIDE CHEMICALS COMPANY

Side Stream Distillation Reduces Cost of Gas Sweetening Operations

Control monoethanolamine contamination by eliminating foreign materials

Monoethanolamine reacts with weak acids such as hydrogen sulfide and carbonic acid at ambient temperatures to form salts. Then, these salts decompose when heated to the boiling point of water, liberating the acidic gases and freeing the monoethanolamine for recirculation to pick up more acid gas. This provides an economic cyclic process for absorbing these undesirable materials from a gas stream. Because of this, practically all gas sweetening in the United States is accomplished by means of the ethanolamines. Union Carbide Chemicals Company's Technical Service Department is continually engaged in research designed to give better engineering service to users of CARBIDE's ethanolamines.

MOST UNITS ARE TROUBLE-FREE

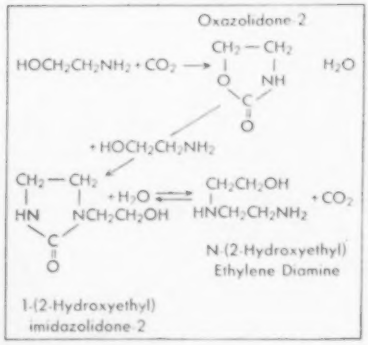
Most of these plants have operated for years without difficulty. However, experience with both aqueous-amine and glycol-amine solutions shows that in some plants the solution gradually loses capacity to absorb acidic gases and may become corrosive.

Research has shown that monoethanolamine contamination can be controlled by a simple side stream distillation system which removes foreign materials and amine degradation products. Thus, sewering can be avoided.

FORMATION OF AMINE DERIVATIVES

Examination of used aqueous and glycol-amine solutions led to the isolation and identification of two monoethanolamine conversion products, namely, 1-(2-hydroxyethyl) imidazolidone-2 and N-(2-hydroxyethyl) ethylene diamine.

It was found that this reaction actually takes place at a very slow rate in some plants handling carbon dioxide. A similar reaction



yielding similar products does not occur when only hydrogen sulfide is present.

EFFECT OF AMINE DERIVATIVES

Formation of imidazolidone reduces the effective monoethanolamine concentration and increases solution viscosity. High concentration may aggravate precipitation of residues in equipment. N-(2-hydroxyethyl) ethylene diamine will pick up acid gases, but release them only with difficulty. The acid gas salt of this stronger amine may contribute to plant equipment corrosion.

DEGRADATION PRODUCTS REMOVED BY SIDE STREAM DISTILLATION

Commercial experience proves that it is possible to remove the imidazolidone from fouled plant solutions by side stream distillation at atmospheric pressure. Batchwise operation handling approximately 1 per cent of the circulated solution has been successful. Vacuum distillation equipment has been equally successful in the case of glycol-amine solutions.

While the substituted ethylene diamine can be efficiently removed in aqueous monoethanolamine systems, it can not be removed from diethylene glycol-monoethanolamine mixtures as its boiling point is within a few degrees of that of diethylene glycol.

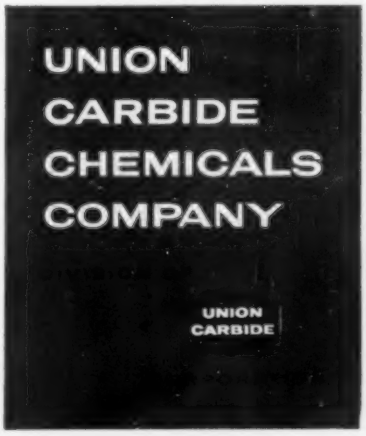
However, the imidazolidone and diamine are in equilibrium. Therefore, reduction of the imidazolidone concentration causes the diamine to revert to imidazolidone. This results in an ultimate removal of both the imidazolidone and the diamine.

In addition, side stream distillation also removes inorganic salts, organic materials with boiling points higher than monoethanolamine, and heat stable monoethanolamine-acid reaction products.

TECHNICAL SERVICE AVAILABLE

CARBIDE offers many technical services to the gas conditioning industry. If you have a gas treating problem, call the nearest CARBIDE technical representative or write Union Carbide Chemicals Company, Department B, 30 East 42nd Street, New York 17, New York.

"Union Carbide" is a registered trade-mark of Union Carbide Corporation



"THERE'S ONE TESTING COMPANY THAT ALWAYS GIVES YOU SOMETHING EXTRA..."

Experience is that *extra something* operators want and need. Johnston Testers has thirty years of testing service . . . over one-half million testing operations . . . that's experience with a capital "E."

What does this mean in added benefits?

Experience means less rig time, less chance of a misrun, more accurate evaluation, complete and reliable bottom hole data. These can be translated into dollar savings for you, the operator.

Why does Johnston usually get the call for the tough drill stem tests, the deep, difficult holes? The answer is simply this. With Johnston equipment, rugged enough to withstand any hole condition, you're assured of the best possible results. The Johnston pressure recorder, the most sensitive and accurate recorder available, gives exacting information. With Johnston personnel, service and test evaluation is the best obtainable.

Give your well every chance to be a producer. The margin for error is reduced when you rely on Johnston experience.

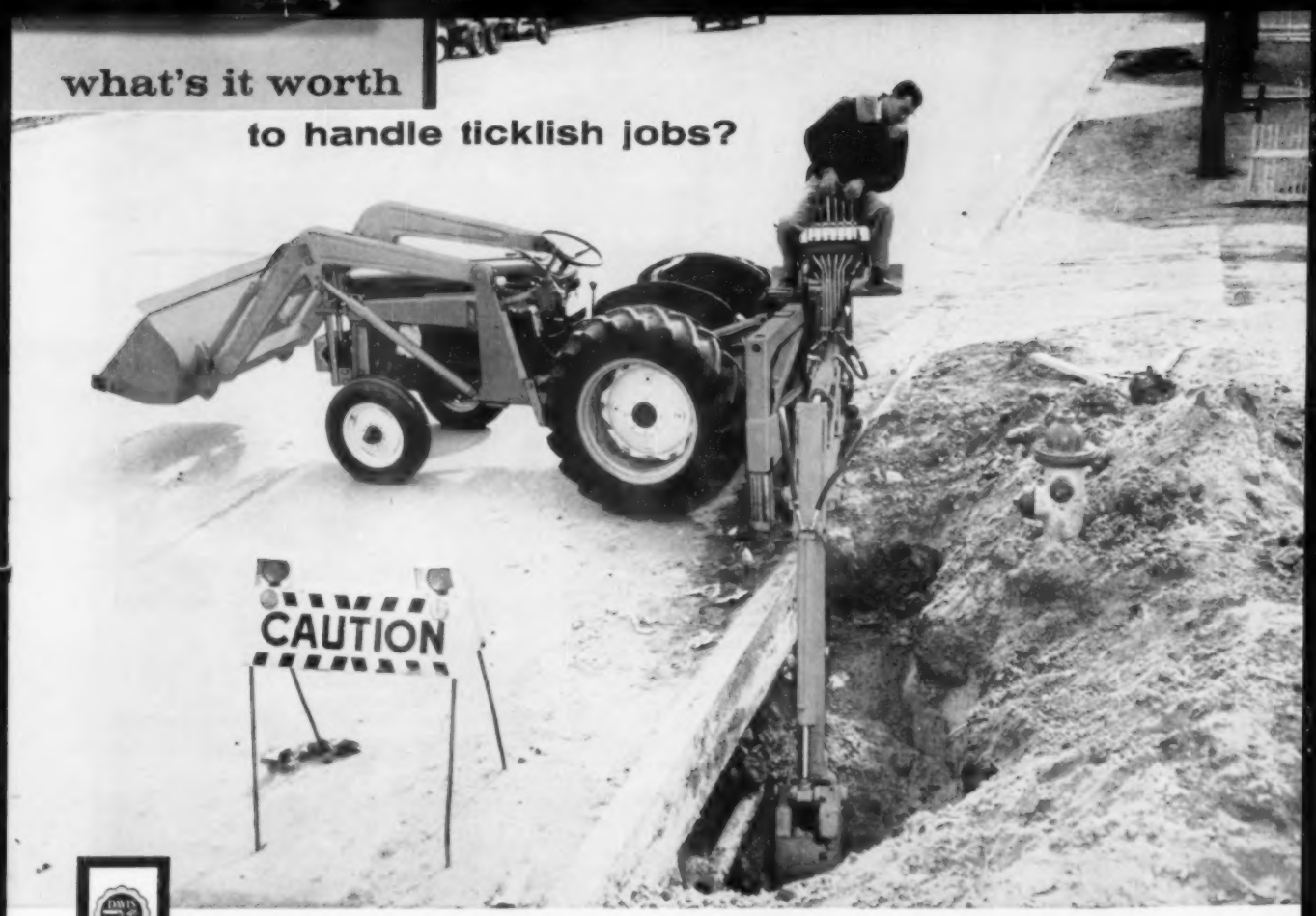
Always call Johnston and be sure.

Johnston Testers, Inc., Houston, Texas; Long Beach, California; Calgary, Alberta, Canada.

A World Of Experience

JOHNSTON TESTERS

what's it worth to handle ticklish jobs?



DAVIS BACKHOE lets you work in Tight Spots!

Digs flush when you need to — only the Model 210 Davis Backhoe has the ability to dig flush alongside walls, buildings, fences. Has 200° continuous operating arc.

A Davis Loader and Backhoe combination will put money in your pocket by outperforming any other rig — pound for pound, dollar for dollar.

Digging near pipelines, conduits, utility mains, or other hidden obstructions is always a tough assignment . . . but a Davis Backhoe will let you handle those ticklish jobs easier and quicker with more safety and profit than any other make. Here's why!

DAVIS LETS YOU SEE YOUR WORK – Unobstructed visibility lets you work fast and accurately without having to "feel" your way around concealed objects or depend upon shouts and hand signals for instructions. Both seat and finger-tip controls swing with the boom, so you always face your work.

DAVIS HAS "ALERT" CONTROLS – Boom, dipper stick, bucket, and stabilizer foot respond lightening-fast to your command.

DAVIS GIVES MAXIMUM MANEUVERABILITY – Because of its exclusive flush digging feature, 200° continuous operating arc, and ability to dig at right angles, Davis lets you operate in places inaccessible to other machines. You can often complete jobs in the time it takes other makes to maneuver into position! . . . ***YET DAVIS STILL COSTS LESS THAN MOST OTHER MAKES!***

Davis Loaders and Backhoes are available for all popular models of International, Ford, Fordson Major, Ferguson, Case, Massey-Harris, Allis-Chalmers, Oliver, John Deere, Minneapolis-Moline, and Work Bull Tractors.

SOLD AND SERVICED EVERYWHERE BY BETTER DEALERS

For the name of your nearest dealers write direct. Please specify make of tractor.

MASSEY-FERGUSON INDUSTRIAL DIVISION

1009 S. WEST STREET • WICHITA 15, KANSAS

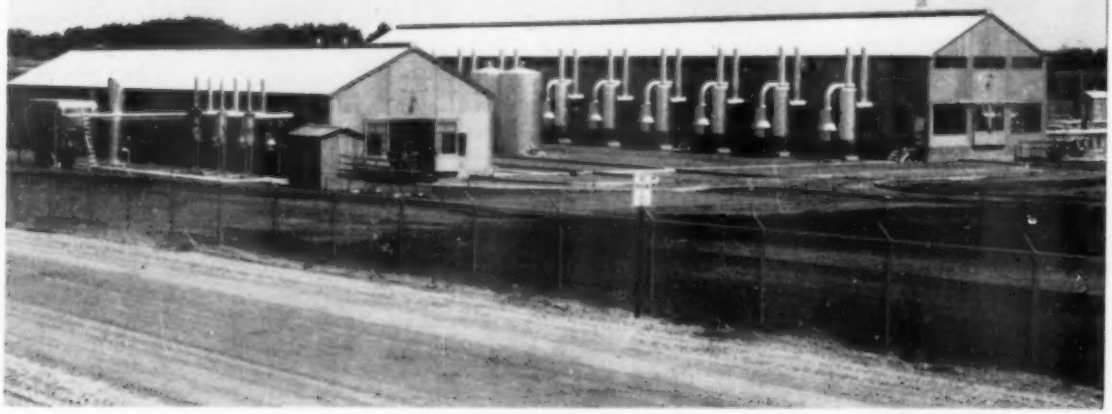
AS SURE AS YOU CAN COUNT ON **DUST...**

You can count on

CYCOILS

for dust protection

Underground gas storage for the City of Detroit is provided by this compressor station of Michigan Consolidated Gas Company at Six Lakes, Michigan. Sixteen Type W Cycoils are on the job here.



AAF Type W Cycoil oil bath air filters clean intake air . . . protect valuable engines and compressors from dust damage—day-in-day-out. Here's maximum dust protection, dependable protection you can count on for even unattended automatic pumping stations.

Cycoils do their job with practically no maintenance. Every Type W Cycoil is automatically self-cleaning—with no moving parts. Periodic removal of sludge from the oil reservoir is all that is needed.

You need this type of low-maintenance positive protection for your operation . . . whether it's automatic or not—whether your units are packaged or stationary. Whatever your need in clean intake air, AAF has the right filter—engineered to save you maintenance dollars. Write today for bulletins.

AAF — American Air Filter COMPANY, INC.

444 Central Avenue, Louisville 8, Kentucky
American Air Filter of Canada, Ltd., Montreal, P. Q.

Type CMS Multi-Duty Filters

Type G Pipeline Air Filters

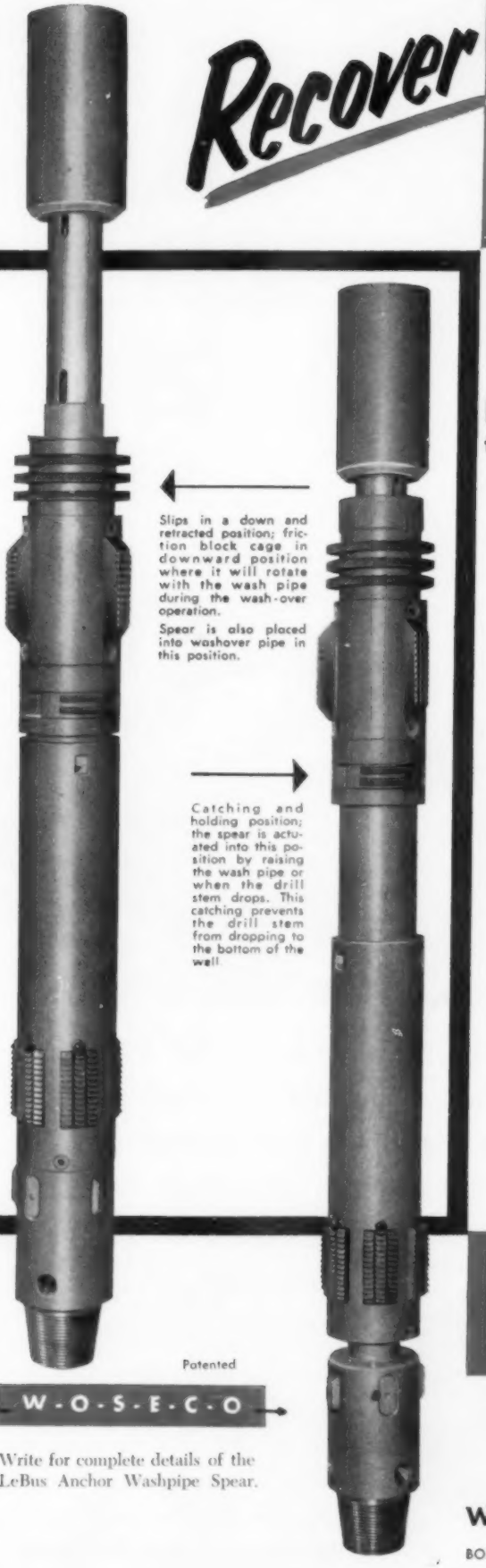
BETTER AIR IS OUR BUSINESS

Type OCH Intake Air Filters

Cycoil Oil Bath Air Filters

Recover STUCK FISH IN ONLY ONE TRIP!

Fishing hazards of stuck drill stem overcome with new recovery technique


Slips in a down and retracted position; friction block cage in downward position where it will rotate with the wash pipe during the wash-over operation.
Spear is also placed into washover pipe in this position.
Catching and holding position; the spear is actuated into this position by raising the wash pipe or when the drill stem drops. This catching prevents the drill stem from dropping to the bottom of the well.

Patented

W-O-S-E-C-O

Write for complete details of the LeBus Anchor Washpipe Spear.

LEBUS ANCHOR WASHPIPE SPEAR
for use with washover pipe

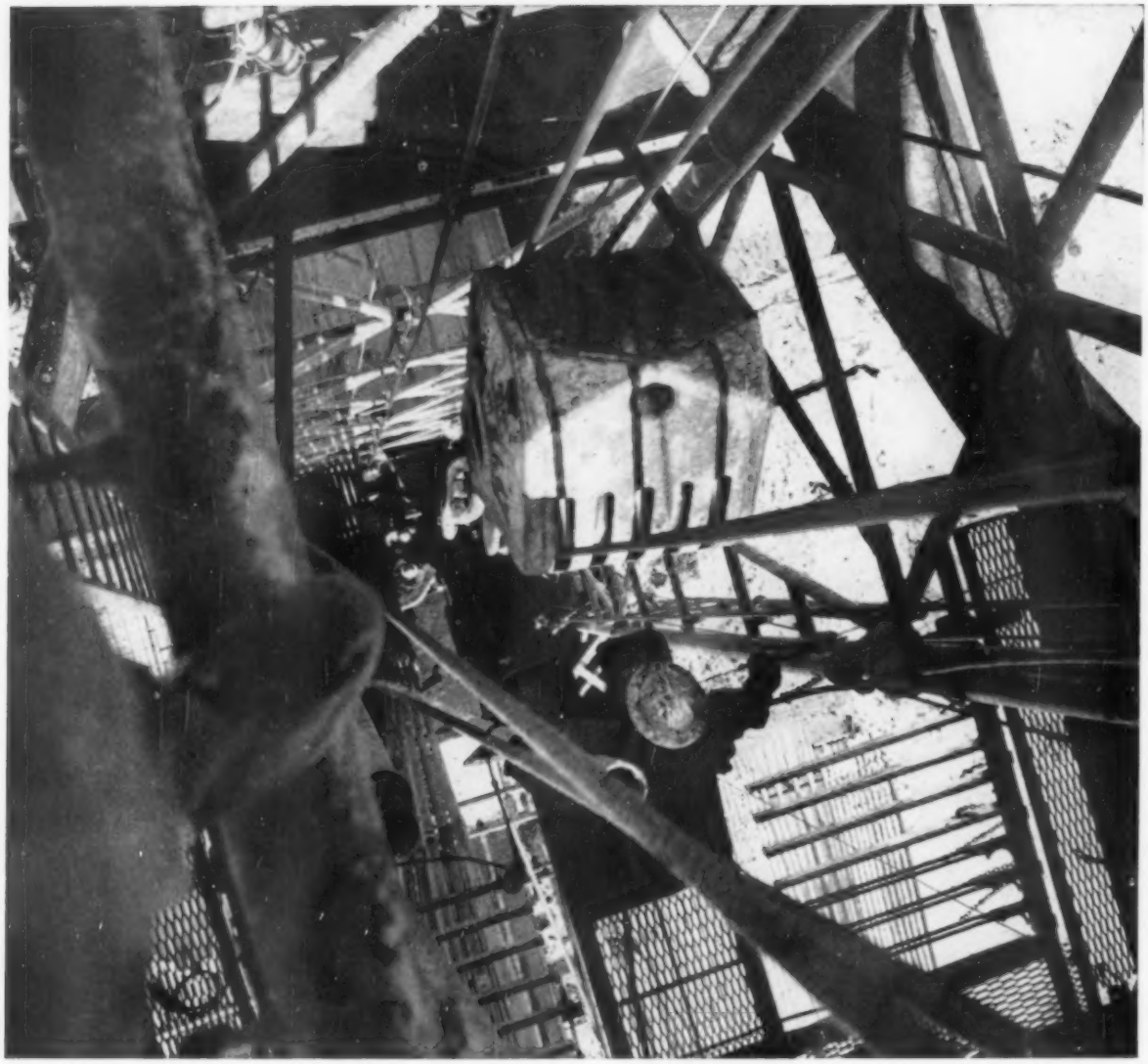
- Stuck Fish is recovered and brought out in ONE TRIP with LEBUS WASHPIPE SPEAR and WASHOVER PIPE when bit and drill stem are stuck off or on bottom.
- When fish is stuck off bottom this spear prevents it from dropping after being washed or reamed loose.
- Can be located in any joint of washpipe without use of special landing collars or nipples.
- This spear is anchored tong-tight inside the Washpipe by the catching slips; this makes it easy to place spear in selected position.
- Anchored Spear slips are released by continued right hand rotation of Washpipe after spear is connected tong-tight to the fish.
- Can be used with knuckle joints, overshots, spears, short or long drill pipe stringers or other essential tools for connecting to the fish.
- Spear is always operative to automatically catch fish when Washpipe is being rotated; at a stand still; being raised or lowered (to make Kelly connection or for freeing the Washpipe and reaming shoe).
- It is not necessary to latch off the catching slips to make Kelly connection; increase the mud pump pressure and raise the Kelly, drill pipe, and Washover pipe so that additional drill pipe can be added to fishing string.
- Left hand rotation of the Washpipe causes the slips to reanchor for backing off any part of the washed over fish with Washpipe.
- Spear operates by both hydraulic and mechanical action when fish starts to fall-either operating within 12 inches.

WRITE FOR COMPLETE DETAILS AND FOLDER DESCRIBING THIS NEW REVOLUTIONARY METHOD

Available through fishing tool and well servicing companies or . . .

WASH OVERSHOT & SPEAR ENGINEERS, INC.

BOX 2352, LONGVIEW, TEXAS PHONE PLaza 8-5522



THERE IS NO BETTER TIME to take a close look at the wire rope you use. A look that assures you that for dollars spent you get **services rendered.** The rope you can look at with assurance is **Roebling Royal Blue Wire Rope.** It has been thoroughly tested in our laboratories and proved in the field. It will repay you in hard work for every dollar you spend. **You get your money's worth.** You get **Roebling Royal Blue Wire Rope.**

ROEBLING

Branch Offices in Principal Cities
Subsidiary of The Colorado Fuel and Iron Corporation

ROEBLING
ROYAL·1105·BLUE
DESIGN
FOR WIRE ROPE
Its ready adaptability is evident wherever power is transmitted. It conforms to unique design requirements. Use wire rope to transmit power.

"I can give you 24 good reasons why this UNIBOLT Christmas Tree Flow Manifold is your best buy"

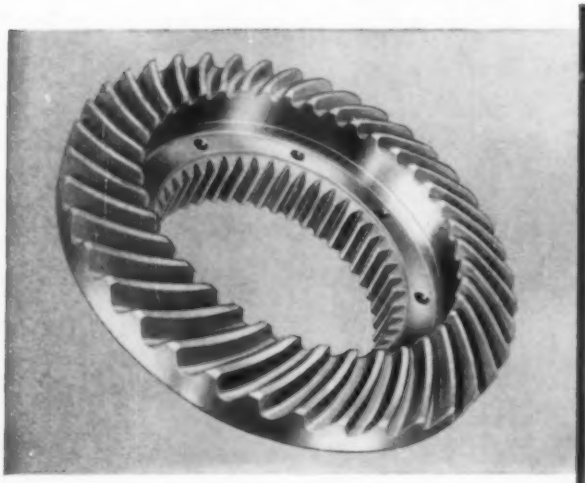
Pound for pound, dollar for dollar, or by any other standard of comparison, UNIBOLT gives you more for your money than any other production manifold or flow control unit.

In addition to numerous mechanical refinements, many of which are exclusive, the UNIBOLT Flow Manifold permits the operator to select the manifold *best suited for his particular well requirements.* Unlike manifolds of fixed design, with UNIBOLT you buy only what you need and nothing more. Using three standard UNIBOLT products—Tee (or Cross for double wing trees), Adjustable Wing Valve, and Positive Choke Body or Cage Nipple and Bean—you have the choice of several combinations. Greater flexibility in arrangement of flow manifolds, complete salvage of parts for use elsewhere, either separately or as a unit, easy field maintenance—these economies and conveniences are yours exclusively with UNIBOLT.

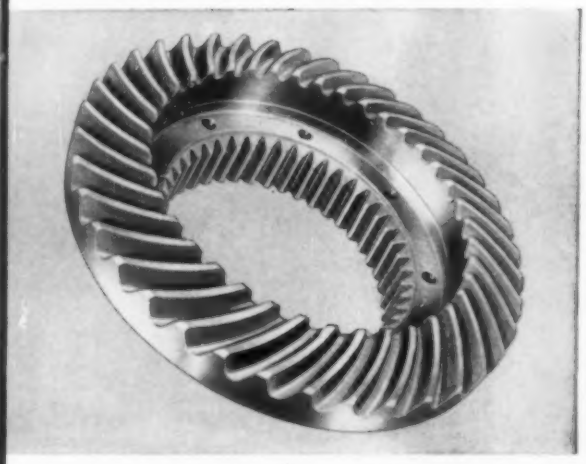
Any UNIBOLT representative will gladly show you all twenty-four reasons why this production manifold is your best buy.

THORNHILL CRAVER CO.
P. O. BOX 1184 HOUSTON, TEXAS

They May Look Alike . . . but they're Not!



Replacement Ring-Gear
Made by Eaton—Axle Division



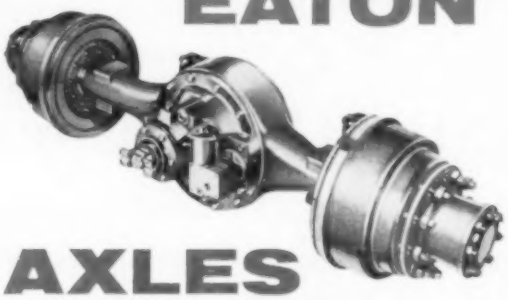
Replacement Ring-Gear
Not Made by Eaton

Only Genuine Eaton Axle Service Parts are Identical to the Original Production Components

Even Eaton Axle parts may wear out and require replacement. When this happens it is important that repairs be made with Genuine Eaton Axle Service Parts. They are identical to the original production components in design, metallurgy, heat treatment, and quality of finish—made to run together with the other axle parts. Eaton replacement parts are held to the rigid quality standards established for axle components and will deliver the same dependable, low-cost kind of service. So when, after thousands of miles of trouble-free operation, it may become necessary to replace worn parts in an Eaton Axle, it's most economical to make these replacements with Genuine Eaton Axle Service Parts.

MORE THAN TWO MILLION

EATON



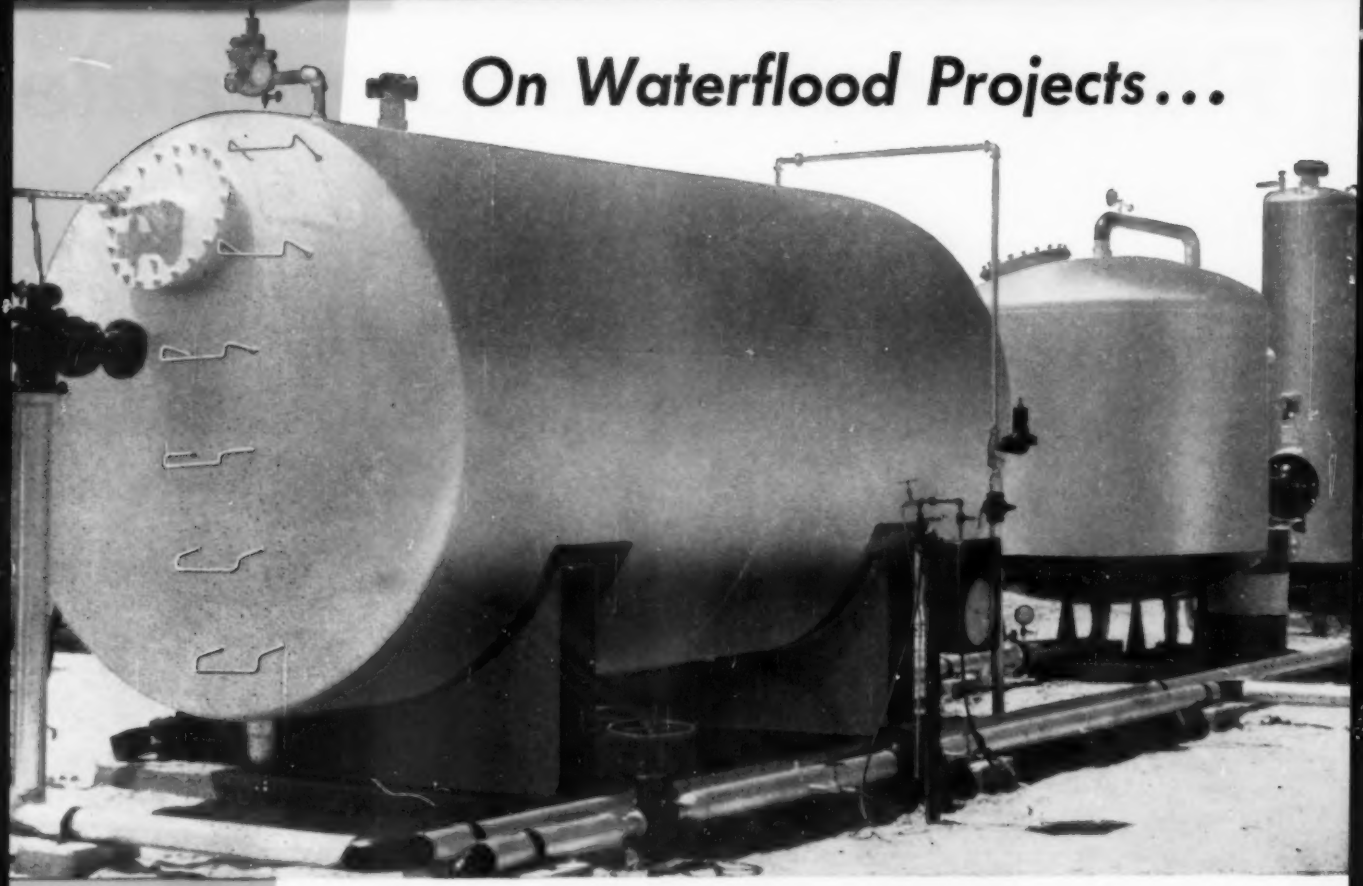
AXLES

IN TRUCKS TODAY

EATON — *AXLE DIVISION*
MANUFACTURING COMPANY
CLEVELAND, OHIO

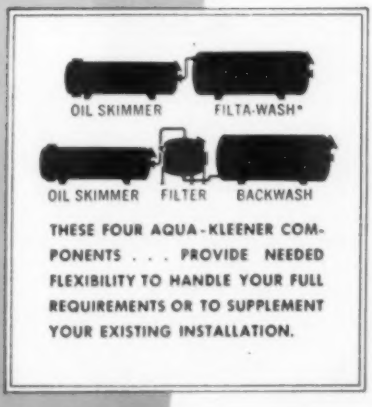
PRODUCTS: Engine Valves • Tappets • Hydraulic Valve Lifters • Valve Seat Inserts • Jet Engine Parts • Hydraulic Pumps Motor Truck Axles • Permanent Mold Gray Iron Castings • Forgings • Heater-Defroster Units • Automotive Air Conditioners Fastening Devices • Cold Drawn Steel • Stampings • Gears • Leaf and Coil Springs • Dynamatic Drives, Brakes, Dynamometers

On Waterflood Projects...



BS&B AQUA-Kleener* Systems

Extend The Service Life Of Water Injection Wells!



THESE FOUR AQUA-KLEENER COMPONENTS . . . PROVIDE NEEDED FLEXIBILITY TO HANDLE YOUR FULL REQUIREMENTS OR TO SUPPLEMENT YOUR EXISTING INSTALLATION.

The BS&B AQUA-KLEENER System was especially developed to meet the water conditioning requirements for water-flooding, sub-surface disposal of salt water and off-shore water disposal.

Numerous AQUA-KLEENER installations, similar to the one pictured above, are today greatly extending the service life of water injection wells by removing solids, oil traces and other contaminants before the water is pumped back underground. If this were not done, the underground formation pores would soon become clogged to the point where the injection well would cease to function.

In addition to its primary function of removing solids and oil traces from lease-produced and surface waters, AQUA-KLEENER also performs the valuable secondary functions of reducing precipitation due to oxidation of iron, minimizing corrosion, holding carbon dioxide in solution, retarding aerobic bacteria growth, and in most cases, eliminating the need for chemical treatment of the water.

If you have a water injection or disposal problem, it will pay you to get full details on AQUA-KLEENER Systems from your BS&B Representative. Or you may write to . . .

* AQUA-KLEENER and FILTA-WASH are trade names of Black, Sivalls & Bryson, Inc.

EFFICIENCY
OVER 60 YEARS
BS&B
RELIABILITY
ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

BLACK, SIVALLS & BRYSON, INC.

Oil & Gas Equipment Div., Dept. 1-A10

P. O. Box 1714

Oklahoma City, Oklahoma

Traditionally dependable

TAYLOR

The Taylor Forge line of Welding Fittings is truly complete, embracing every size, type, thickness and material for any service condition.

Because extreme dimensional accuracy of the assembled union is required in order to assure precise metering, Taylor Forge Orifice Flange Unions are specified for this exacting service by the larger users throughout the world.

Forged and fabricated booster nozzle assembly for guided missile. Both hammer and press forging methods are used in producing this part.

Spiral-Weld Pipe, our original product, (first made as spiral riveted pipe nearly 60 years ago), remains to this day a major item and its use continues to expand. Its money-saving features are widely recognized in many services.

Electric Fusion Welded Pipe is made in sizes from 14" OD to 96" OD with wall thicknesses to 1.531", and in a variety of materials, including stainless and alloy steels.

in many different fields

FORGE Welding Fittings and Forged Flanges

FORGED, ROLLED AND EXTRUDED PRODUCTS IN CARBON AND ALLOY STEELS, STAINLESS STEEL and all other ferrous and non-ferrous metals

Wherever piping is important—as in power, processing, gas transmission and distribution, heating, air conditioning and many other fields—Taylor Forge is recognized as the leading manufacturer of highest quality *Welding Fittings* and *Forged Flanges* of every size, type and wall thickness or pressure standard.

Many other types of forged, rolled and extruded products help make Taylor Forge depended upon in many different fields throughout industry. One thing all have in common is the dependability, the integrity that has always been associated with the name TAYLOR FORGE.

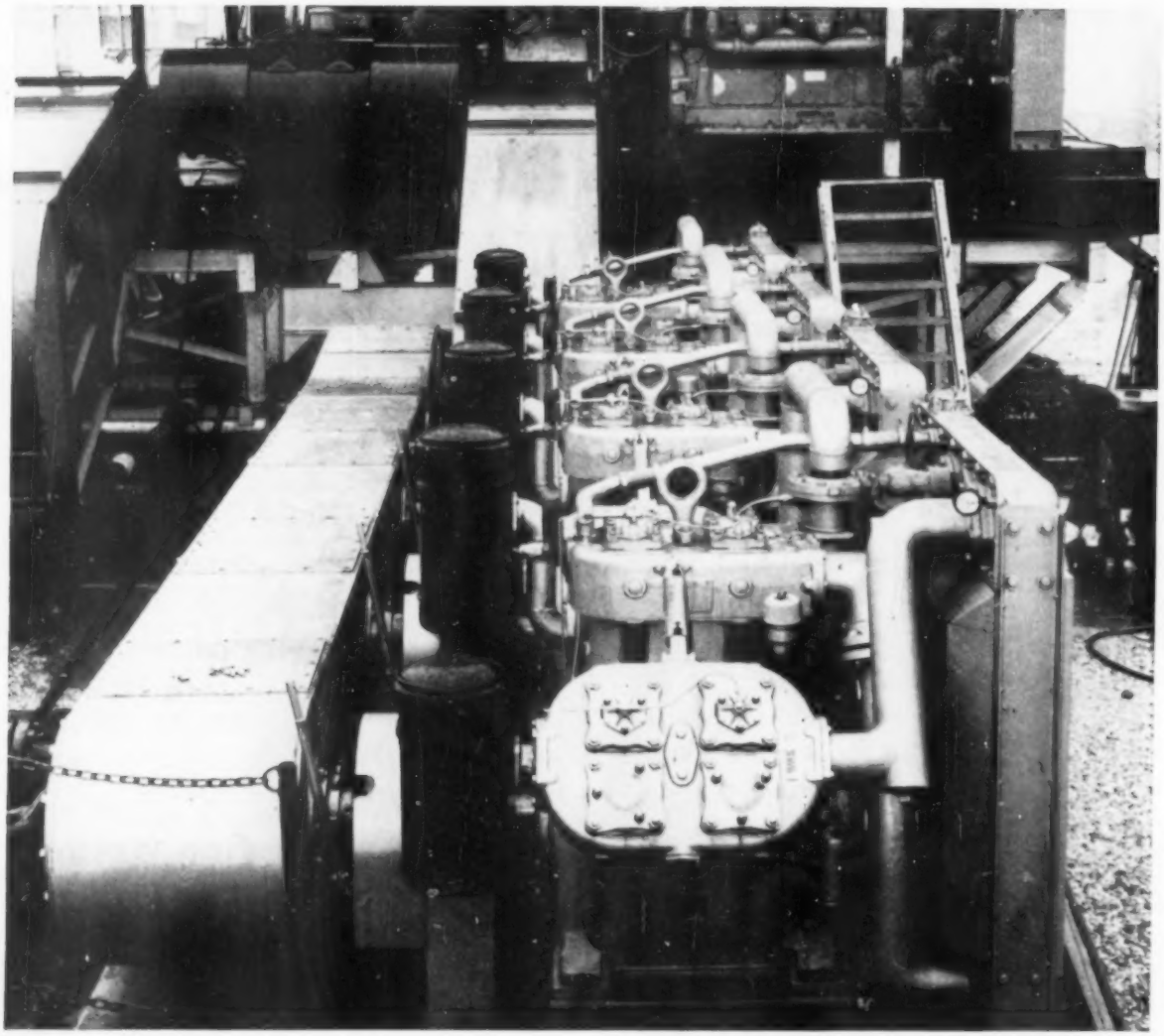
Taylor Forge & Pipe Works

General Offices and Works: P.O. Box 485, Chicago 90, Illinois
Plants at: Carnegie, Pa.; Somerville, New Jersey; Gary, Indiana; Houston, Texas; Fontana, Calif.; Hamilton, Ont., Canada

District Sales Offices: New York, Boston, Philadelphia, Pittsburgh, Atlanta, Chicago, Houston, Tulsa, Los Angeles, San Francisco, Seattle, Toronto, Calgary, Montreal.

Taylor Forge was America's first and is still the country's foremost manufacturer of Welding Necks, Nozzles, Large Diameter Flanges and similar boiler, heat exchanger and other pressure vessel components. Such parts are made in any size and material for any service condition.

This Gas Pipeline Combination Valve Setting and River Crossing Header with integral venturi reduction is typical of the many different forged headers with contoured outlets produced by Taylor Forge for the petroleum processing and gas transmission industries.



An assembly of four Gardner-Denver WBK-C4 compressor units.

Engineered for your air drilling needs

Is your air drilling project in the planning stage? Here's a compressor package designed especially for it—the Gardner-Denver WB air drilling unit. Each packaged unit consists of water-cooled compressor, intercooler and aftercooler, engineered to deliver cooler air at the header. The WB is built for continuous service and is easily maintained at the drilling site.

Gardner-Denver has the facts

Get in touch with your Gardner-Denver compressor specialist. His knowledge of circulation problems is backed by three generations of Gardner-Denver service to the drilling industry. He can help plan the correct installation for any air drilling or mud aeration application. Gardner-Denver compressor specialists are located throughout the oil fields.

ENGINEERING FORESIGHT—PROVED ON THE JOB
IN GENERAL INDUSTRY, CONSTRUCTION, PETROLEUM AND MINING

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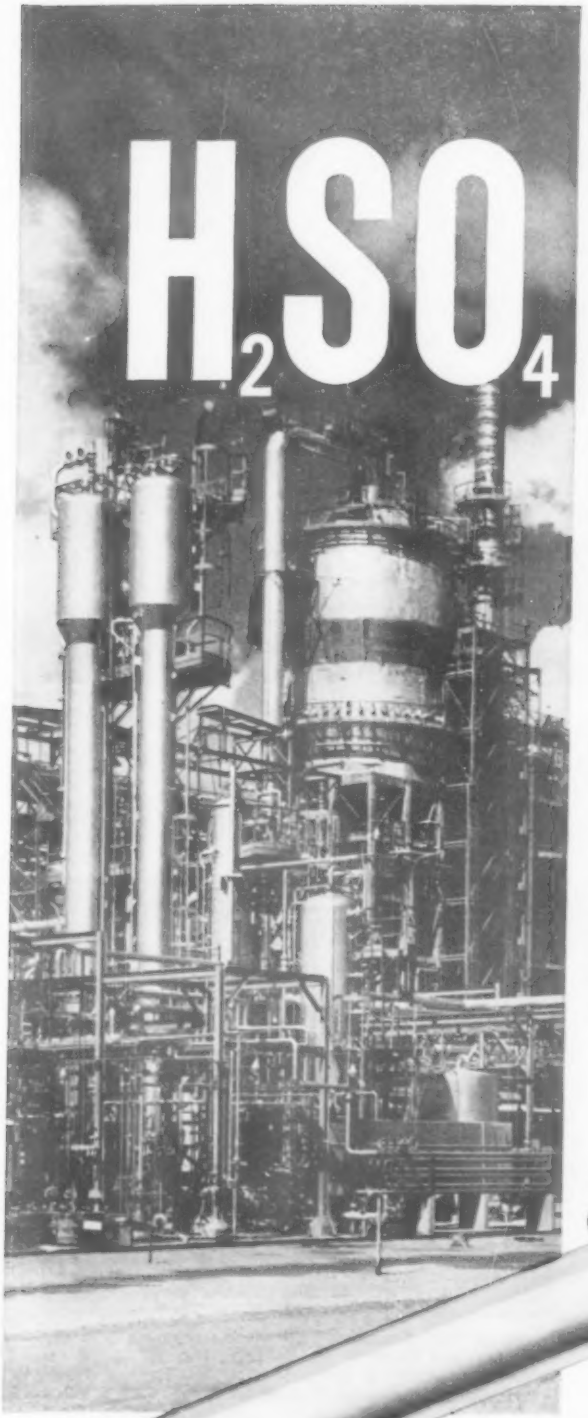


Sulfuric acid in any concentration at any temperature to 500°F...

CAN'T CORRODE FLUOROFLEX®-T PIPE

TEFLON® liner in thermal equilibrium with housing

Sulfuric, hydrochloric, nitric, hydrofluoric—*any* acid is harmless to Fluoroflex-T piping.

Universally inert liner. Steel pipe and fittings are lined with Fluoroflex-T... a patented, high density, *non-porous* compound of Teflon.

Liner and housing are in thermal equilibrium through an exclusive process developed by Resistoflex. It compensates for thermal expansion differential between the Teflon and the pipe housing, eliminating fatigue collapse, and cracking at the flange.

Solves problems, saves downtime, saves money. Type S piping installed in steam cooking process for recovering sulfuric acid from coal tar sludge at 250°F and 50 psi has been in service over a year with no maintenance difficulties.

See how Fluoroflex-T Type S piping systems can end problems of corrosion, erosion and contamination for you. Send for detailed Bulletin TS-1A. Dept. 135, RESISTOFLEX CORPORATION, Roseland, New Jersey. Other Plants: Burbank, Calif., Dallas, Tex.

® *Fluoroflex is a Resistoflex trademark, reg., U. S. pat. off.*
® *Teflon is DuPont's trademark for TFE fluorocarbon resins*

RESISTOFLEX

Complete systems for corrosive service

LINED STEEL PIPE • FLANGED FLEXIBLE HOSE • BELLOWS • ELBOWS • TEES • REDUCERS • DIP PIPES & SPARGERS • LAMINATED PIPE

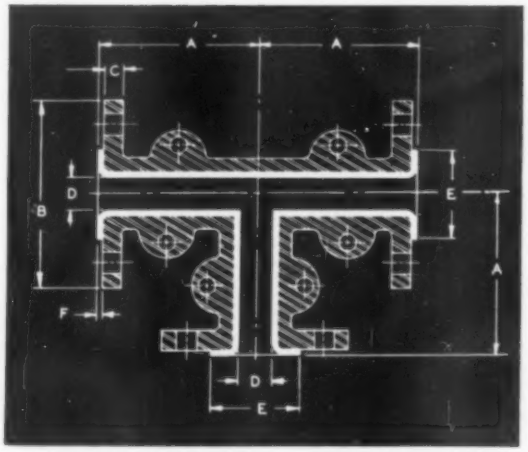
Another "Quality Controlled" application of Teflon by Doré

DORE' TEES LINED WITH TEFLON*
Have Standard** Face to C/L Dimensions.

This exclusive feature of Doré Teflon lined Tees means you can plan corrosion-free, contamination-proof piping layouts with the same specifications and install them with the same efficiency as you do standard piping. There are no special calculations required . . . no "off-size" fittings to complicate and upset your piping installation schedule. And only Doré Tees have these standard dimensions.

Doré Tees are lined with pure, white Teflon, 1/8" thick. The Teflon lining is tough, dense, hole-free. IT HAS NO WELDS. The Teflon lining, including the flange face seals, are molded in one piece. The seal covering the raised face of the flange is perfectly flat and smooth . . . not wavy. Flanges make up leakproof without the use of an extra flange gasket.

Doré engineered and "quality controlled" Teflon lined pipe and fittings can be the solution to corrosion and contamination problems. Write for bulletin K-57-A, giving us information about special problems you have.



Face to C/L dimensions ("A") are in accordance with ASA 125# Cast Iron Flange Fittings standards. Tees are ductile iron with flanges drilled to ASA 125# standards. Pressure Rating: 400 psi, Vacuum Rating: Full, Temperature Rating: -90°F to 500°F.

*Du Pont's registered Trademark for fluorocarbon resins, including tetrafluoroethylene resins.

**ASA 125# Cast Iron Flanged Fittings.

John L. Doré Co.

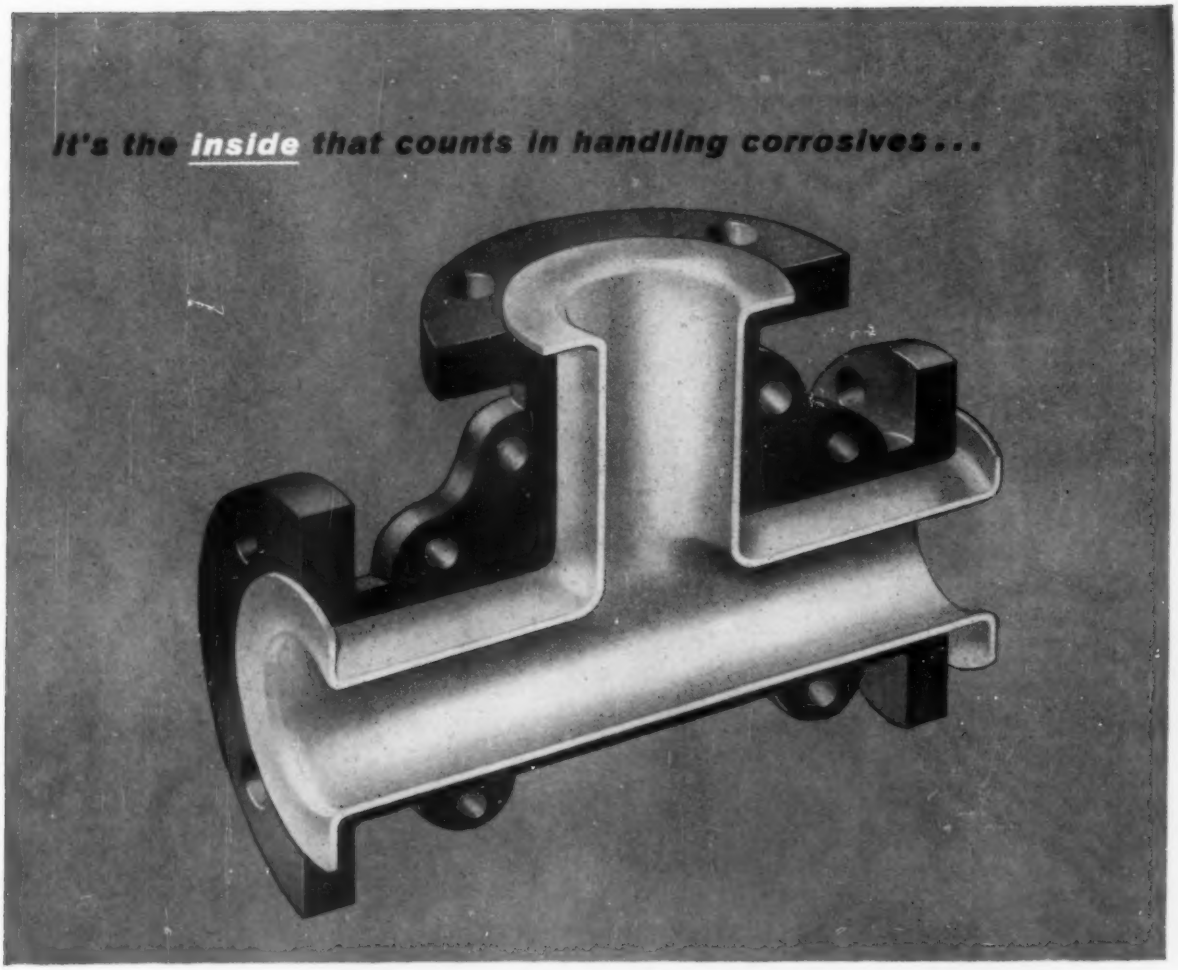
5406 SCHULER • P. O. BOX 7772 • HOUSTON 7, TEXAS

EXPORT: 1505 RACE ST. • PHILADELPHIA 2, PA., U. S. A.

CABLE ADDRESS: DOREX

SALES ENGINEERS
FOR JOHN L. DORE, INC.

DU PONT'S TEFLON
HI-QUALITY NYLON



Protect against costly breakdowns by using pipe lined with a TFE-fluorocarbon resin

In handling corrosive materials, maintenance can be a major problem. A single shutdown for pipe repair can cost you more than an entire piping installation. In corrosive services, the only pipe worth using is pipe you don't have to replace . . . pipe lined with a TEFLON TFE-fluorocarbon resin.

Pipe lined with a TFE-fluorocarbon resin is unaffected by the most powerful acids, bases, and solvents. For example, this pipe replaced stainless steel pipe in a process stream containing sulfuric acid, sulfur, and sodium sulfate in water, under pressure, at a temperature of more than 240°F. Corrosion was eliminated, and, with it, the resulting contamination with metal ions which can often act as catalysts. The non-adhesive surface of the liner prevents plugging by the high viscosity material.

A TFE resin pipe lining has many other advantages. It won't shatter under vibration or thermal or physical shock, like brittle liners. It can be used at temperatures up to 500°F. The liner flared over the flanges provides complete protection for the steel from the process fluid, and eliminates the need for additional gasketing. And now, you can get a complete assortment of standard sizes of flanged pipe and fittings including tees, elbows, and reducers all lined with Du Pont TEFLON TFE resin.

To minimize maintenance and downtime in petroleum and petrochemical services, install pipe lined with TEFLON TFE resins. Check with your local supplier for details, or, for more information, write to: **E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Room 2810, Du Pont Building, Wilmington 98, Delaware.**

IN CANADA: Du Pont Company of Canada (1956) Limited, P. O. Box 660, Montreal, Quebec.

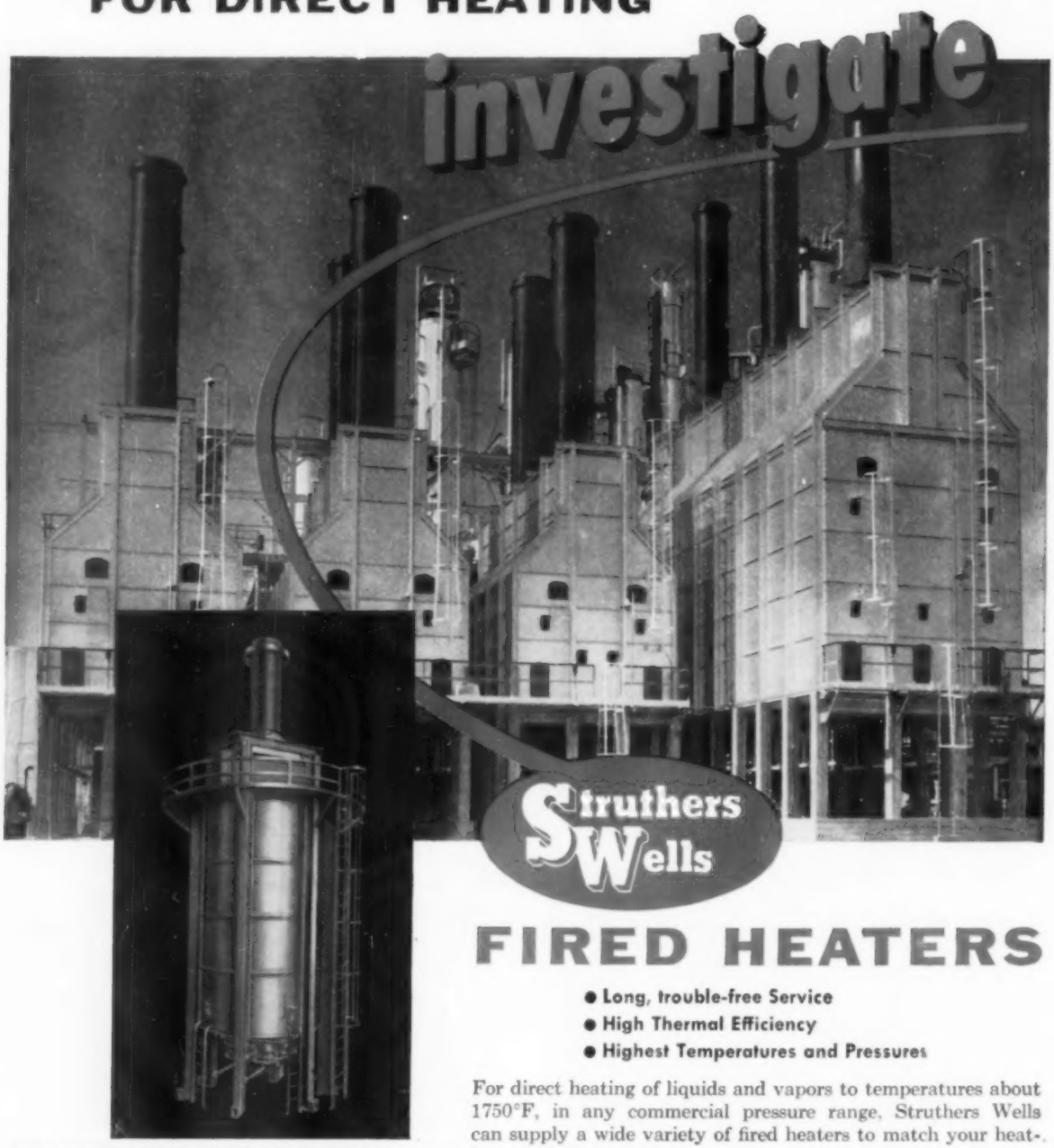
DU PONT
REG. U.S. PAT. OFF.

TEFLON®
TFE-FLUOROCARBON RESINS

TEFLON is Du Pont's registered trademark for its fluorocarbon resins, including the TFE (tetrafluoroethylene) resins discussed herein.

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

FOR DIRECT HEATING



FIRED HEATERS

- Long, trouble-free Service
- High Thermal Efficiency
- Highest Temperatures and Pressures

For direct heating of liquids and vapors to temperatures about 1750°F, in any commercial pressure range, Struthers Wells can supply a wide variety of fired heaters to match your heating requirements.

Many units are being supplied to the petroleum and petrochemical industries, for direct heating of oil and hydro-carbon gases, and for cracking service. Equipment is supplied to heat gases to high temperature for chemical plant service, and for thermal and catalytic cracking of chemical compounds.

Heating units and complete systems have been supplied using circulating mediums, to temperatures above 1700°F.

Special heaters supply high temperature water or superheated steam, at high pressures.

Standard designs allow us to make quick quotations and fast deliveries, for most services.

Write on your letterhead for new Bulletin A-46, describing standard heaters.

STRUTHERS WELLS CORPORATION

WARREN, PENNA.

STRUTHERS WELLS PRODUCTS

PROCESSING EQUIPMENT DIVISION

Crystallizers . . . Direct Fired Heaters . . . Evaporators . . . Heat Exchangers . . . Mixing and Blending Units . . . Quick Opening Doors . . . Special Carbon and Alloy Processing Vessels . . . Synthesis Converters

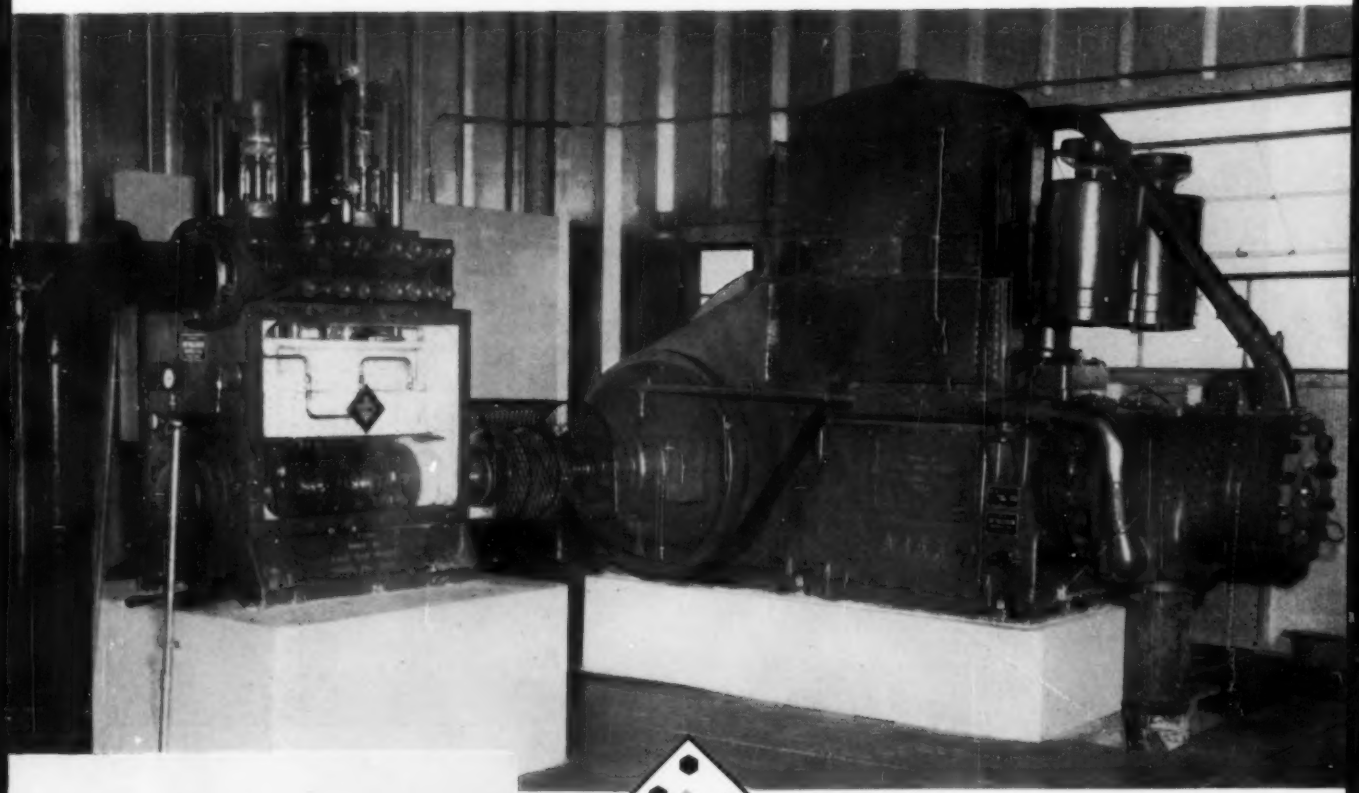
BOILER DIVISION

BOILERS for Power and Heat . . . High and Low Pressure . . . Water Tube . . . Fire Tube . . . Package Units

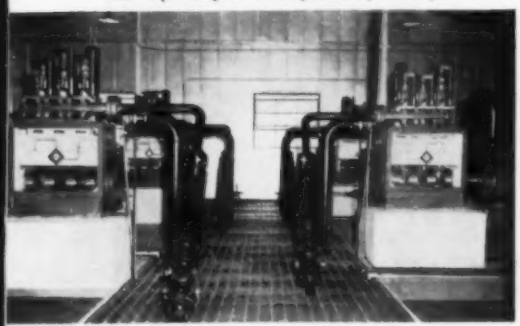
FORGE DIVISION

Crankshafts . . . Pressure Vessels . . . Hydraulic Cylinders . . . Shafting . . . Straightening and Back-up Rolls

You can be sure when you go Ajax all the way!



A modern West Texas waterflood installation—four Ajax Engines driving four Ajax Pumps.



AJAX

GAS ENGINES PRESSURE PUMPS

The good hard sense in going "AJAX all the way" shows up year after year. Match an Ajax Gas Engine with an Ajax Pump and you get a balanced workhorse team. You get undivided responsibility for maintenance. You benefit by a single interest of the builder in the performance of engine and pump alike. • Small wonder that experienced production men agree, "If you want to be *sure* of your waterflood jobs—go AJAX all the way!" *Ask your supply man.*

Ajax IRON WORKS

Builders of GAS AND OIL ENGINES • PRESSURE PUMPS

CORRY, PENNSYLVANIA

Oil Field Distributors: THE NATIONAL SUPPLY CO., PITTSBURGH, PA. • R. B. MOORE SUPPLY CO., BOLIVAR, N. Y. • BETHLEHEM SUPPLY CO., TULSA, OKLAHOMA

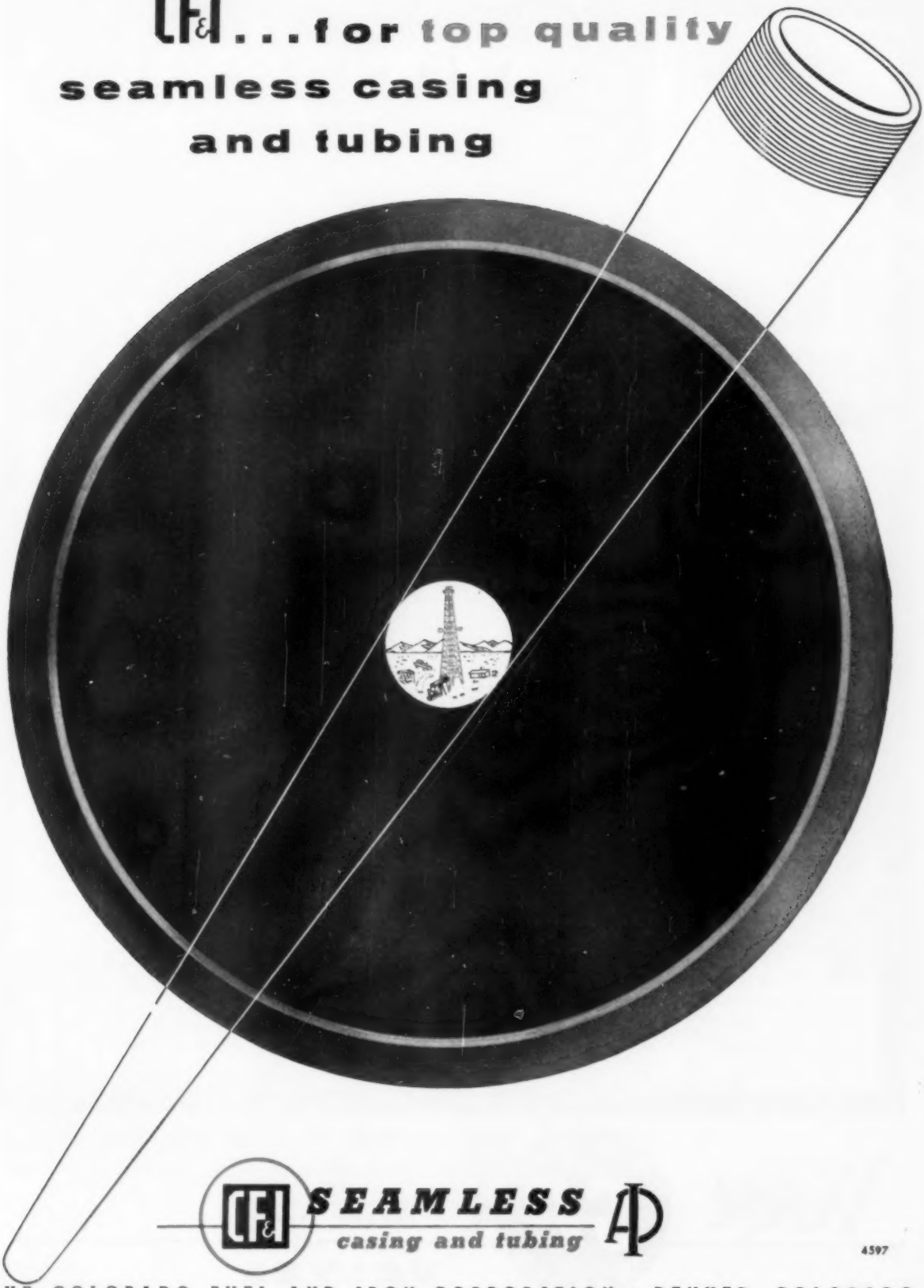
"ROUGHNECKS" IN ACTION . . .

And this phrase describes the *equipment*, as well as the men who handle such back-breaking work! Bearings, for instance, have to operate efficiently under tremendous loads around the clock . . . day in, day out. Bower cylindrical roller bearings are engineered for jobs like this—incorporating such advanced design features as integral thrust shoulders and raceway, and improved internal construction. Painstaking quality control makes them last longer, require little or no maintenance. If you use bearings, either in original equipment or for replacement purposes, specify Bower!

BOWER ROLLER BEARING DIVISION
FEDERAL-MOGUL-BOWER BEARINGS, INC. • DETROIT 14, MICHIGAN

BOWER TAPERED • CYLINDRICAL • JOURNAL ROLLER BEARINGS

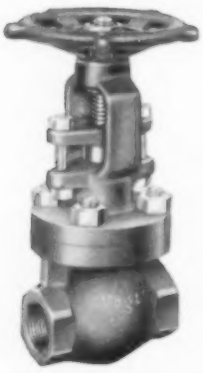
CF&I . . . for top quality seamless casing and tubing



CF&I SEAMLESS casing and tubing

4597

THE COLORADO FUEL AND IRON CORPORATION • DENVER, COLORADO

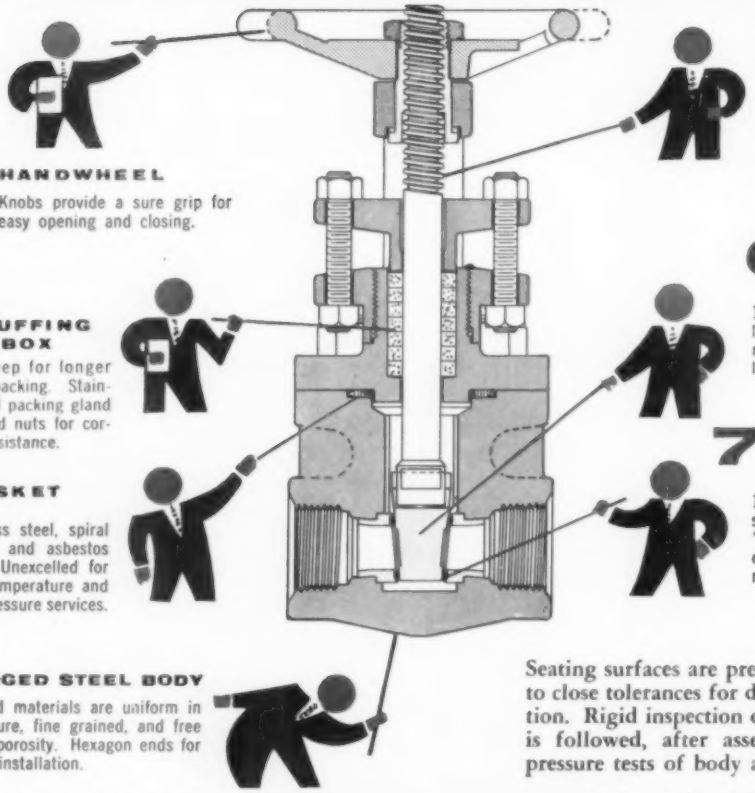


150-800 POUNDS SERVICE
2000 POUNDS COLD, W.O.G.
SIZES ¼" THRU 2"

A NEW Vogt

ROUND BOLTED BONNET, BOLTED GLAND FORGED STEEL GATE VALVE

with 7 superior features



1 HANDWHEEL

Knobs provide a sure grip for easy opening and closing.

2 STUFFING BOX

Extra deep for longer life of packing. Stainless steel packing gland studs and nuts for corrosion resistance.

3 GASKET

Stainless steel, spiral wound, and asbestos filled. Unexcelled for high temperature and high pressure services.

4 FORGED STEEL BODY

Forged materials are uniform in structure, fine grained, and free from porosity. Hexagon ends for easy installation.

5 STEM

13% Chrome stainless steel. A special high melting point alloy yoke nut assures prolonged wear resistance.

6 WEDGE

13% Chrome stainless steel of approximately 500 Brinell for longer wear.

7 SEATS

13% Chrome stainless steel, hard faced with *HAYNES STELLITE or equivalent for stubborn resistance to seat wear.

Seating surfaces are precision machined to close tolerances for drop tight operation. Rigid inspection of finished parts is followed, after assembly, by final pressure tests of body and seats.

*Trade mark of Union Carbide Chemicals Co.

Address Dept. 24A-FO.

Vogt GENERAL GP PURPOSE Vogt FOR BETTER VALVES

HENRY VOGT MACHINE COMPANY, Louisville, Ky.

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Camden, N. J., St. Louis, Charleston, W. Va., Cincinnati.

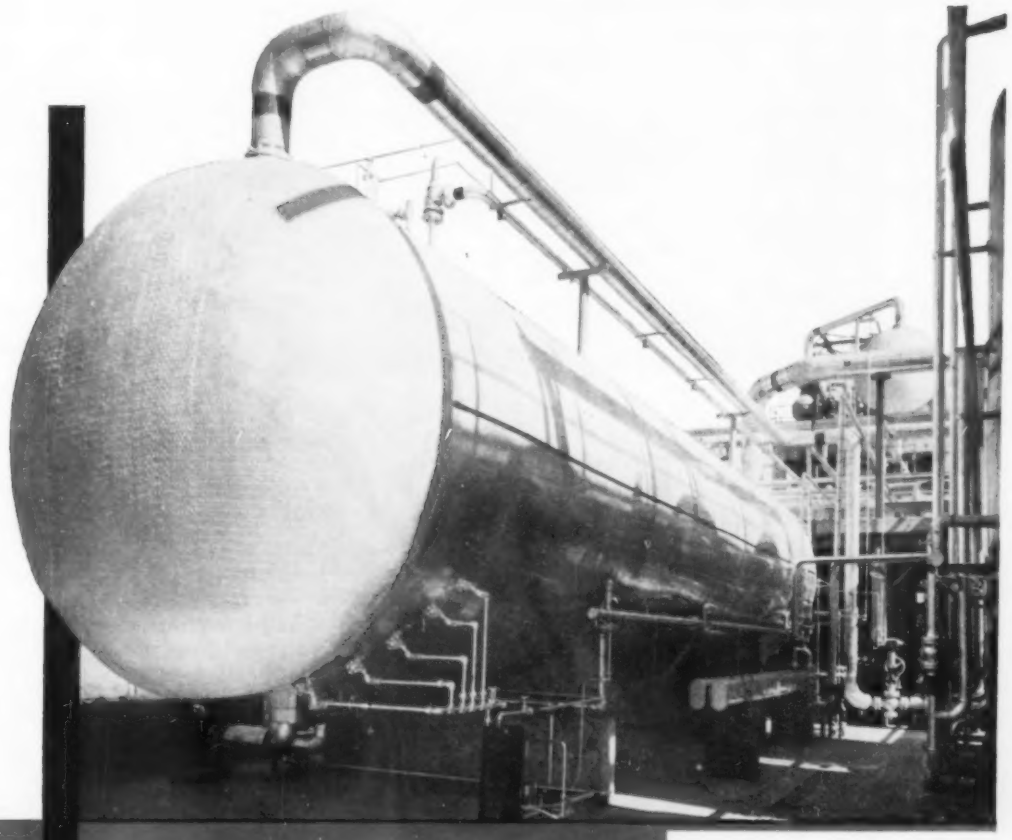
FORGED STEEL

VALVES

TRETOLITE DESALTING MAKES IT POSSIBLE FOR ANY REFINERY TO CHARGE **ANY** CRUDE

when you specify desalting, remember these facts about Tretolite chemical desalting:

1. 98 to 100% salt removal.
2. Lowest per barrel throughput installation cost.
3. Unsurpassed service organization.
4. A choice of rental or purchase plans.
5. Guaranteed performance.



TRETOLITE COMPANY

DIVISIONS OF PETROLITE CORPORATION

369 MARSHALL AVENUE, ST. LOUIS 19, MISSOURI

5516 TELEGRAPH ROAD, LOS ANGELES 22, CALIFORNIA

Your Tretolite Refinery Service Engineer will gladly provide you with cost figures, operating data and complete information. He will arrange for preliminary laboratory tests.

CALL HIM TODAY

Chemicals and Services for the Petroleum Industry

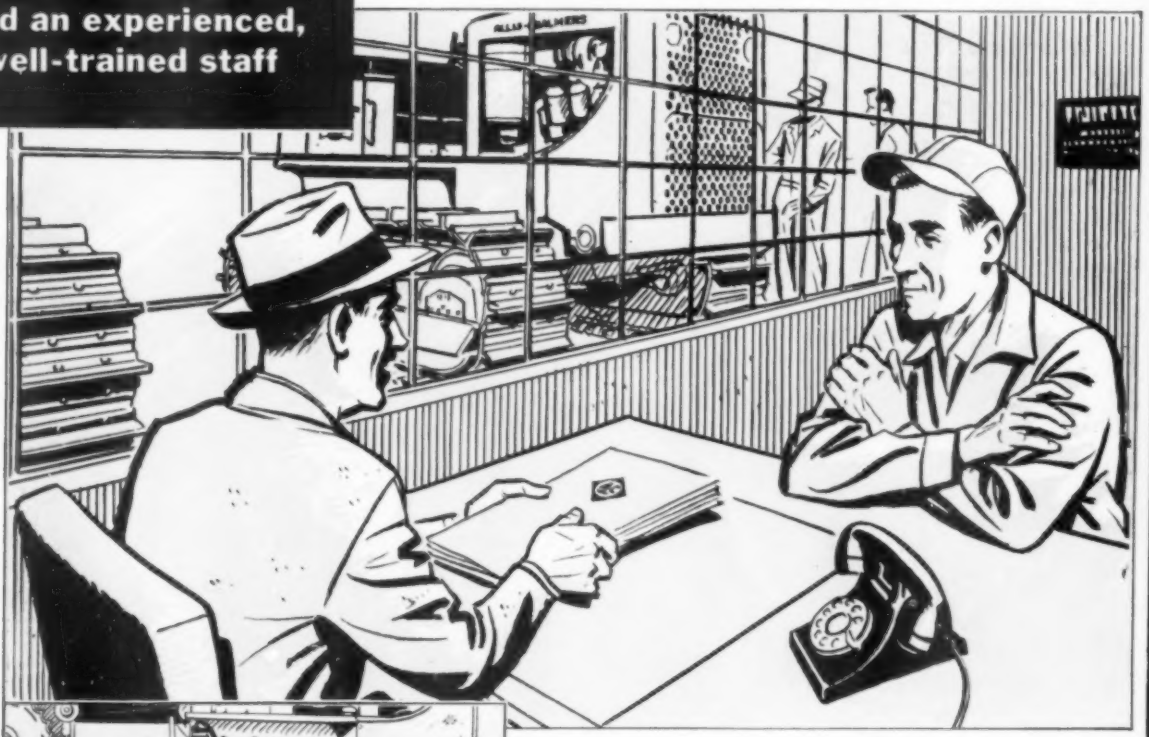
DEMULSIFICATION • DESALTING • PARAFFIN REMOVAL
CORROSION INHIBITING • SCALE PREVENTION
WATER DE-OILING • INJECTIVITY STIMULATION

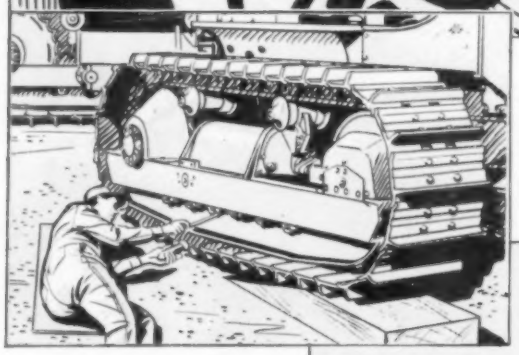
TD-58-3

Your Allis-Chalmers dealer

...backed by modern facilities and an experienced, well-trained staff

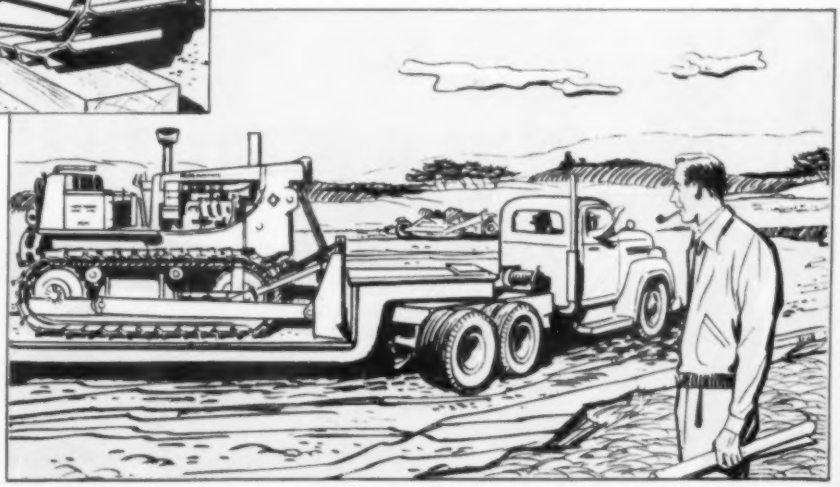
Your Allis-Chalmers dealer *knows* the equipment he sells. He can give you the expert service in shop and field that results in "like-new" performance from every Allis-Chalmers unit in your fleet... keeps them producing on your jobs.



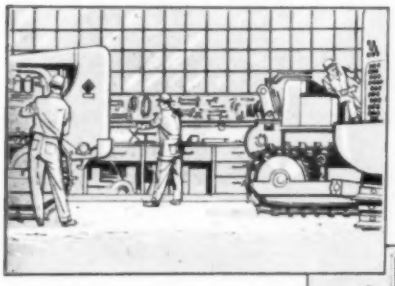


Detailed information on maintenance, adjustments and other facts on care of the machinery is delivered with the equipment. Operating tips are passed along to your men—to help them get started right and get the most from their equipment.

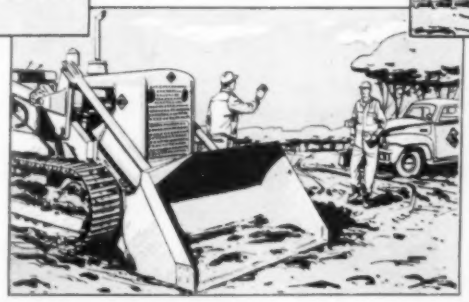
Careful pre-delivery servicing assures that Allis-Chalmers construction machines have been thoroughly checked ...and that they're ready for work as soon as you get them.



is a specialist in service



Shop service at your Allis-Chalmers dealer is fast and efficient—because it's handled by factory-trained men, using factory-approved tools, equipment and methods. Specialized mechanics and special facilities all help to speed service.



Scheduling checkups with your Allis-Chalmers dealer will insure that proper maintenance procedures are followed . . . stop trouble before it starts . . . keep your machines producing.

Prompt field service—a call—any time, day or night—brings a qualified serviceman and a fully equipped "mobile workshop." Result—problems can be quickly and accurately solved . . . equipment put back on the job with minimum delay.

. . . backed by a ready stock of original specification parts

ENGINEERED RIGHT

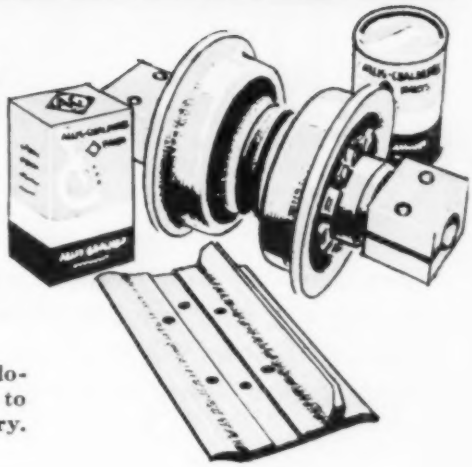
Allis-Chalmers parts are designed as original equipment . . . benefit from intensive metallurgical research. And each comes from the drawing boards of experienced construction machinery engineers.

MANUFACTURED RIGHT

Precision-made parts assure long-life service. They're made by skilled craftsmen on modern industrial machinery and are subjected to original-equipment inspection and testing.

TO PERFORM RIGHT

Each part is made of top-quality material, heat-treated to correct hardness and made to exact specifications. You can depend on them for full-capacity production on the toughest jobs you have.



The men of your Allis-Chalmers dealer organization know local conditions. Look to them for equipment recommendations to fit your job requirements . . . for true value in used machinery.

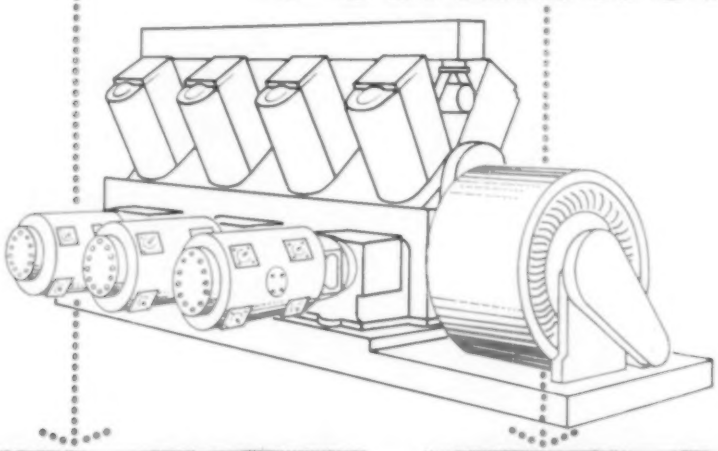
ALLIS-CHALMERS, CONSTRUCTION MACHINERY DIVISION, MILWAUKEE 1, WISCONSIN

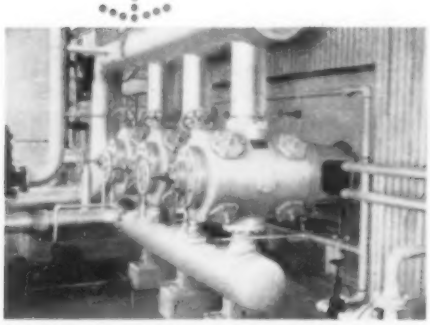
Look ahead... *move ahead*...and stay ahead

with ALLIS-CHALMERS

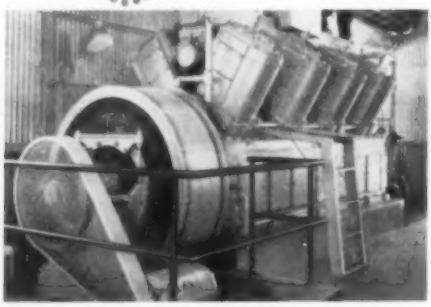
a COMPRESSOR in summer...

a GENERATOR in winter





Exterior view of compressor house at Reef Fields Gasoline Corp., Big Springs, Texas, showing compressor cylinders of the I-R gas-engine-compressor and generating unit beyond the firewall.



Interior view, showing the 275-kw generator on the I-R gas-engine-compressor and generating unit. Generator rotor provides proper flywheel effect when unit operates as compressor.

Double-Duty unit demonstrates versatility and smooth control of Ingersoll-Rand FOUR-CYCLE Gas-Engine Compressors

Why use two when one will do? The unusual combination shown above does two completely different jobs for the Reef Fields Gasoline Corp. It consists basically of an Ingersoll-Rand SVG gas-engine-compressor with an A-C generator in place of the usual flywheel.

In the summer months, this 440-hp unit is used as a refrigeration compressor. Its compressor cylinders boost propane gas to 200 psi, for use as a coolant in butane and propane recovery.

In winter when the refrigeration is not needed, the unit is put on full generator service. Its 275-kw generator alternates with four regular Ingersoll-Rand PVG gas-engine-generator units.

This double-duty application was made possible by the stability and smooth control inherent in every I-R 4-cycle, V-angle gas-engine compressor. The 4-cycle smoothness, so essential for A-C generator drive, also is important for compressor service: I-R units operate equally well from full load to no load and from full speed to half speed.

Whether you need *compression*, *generation*, or *both*, you're sure of smooth, dependable performance with an I-R gas-engine unit. Your Ingersoll-Rand representative will be glad to give you complete information and help you select the most economical unit for the job.

Ingersoll-Rand

11 Broadway, New York 4, N.Y.

4-CYCLE V

COMPRESSORS • GAS & DIESEL ENGINES • PUMPS • AIR & ELECTRIC TOOLS • CONDENSERS • VACUUM EQUIPMENT • ROCK DRILLS

Why gamble with directional surveys?

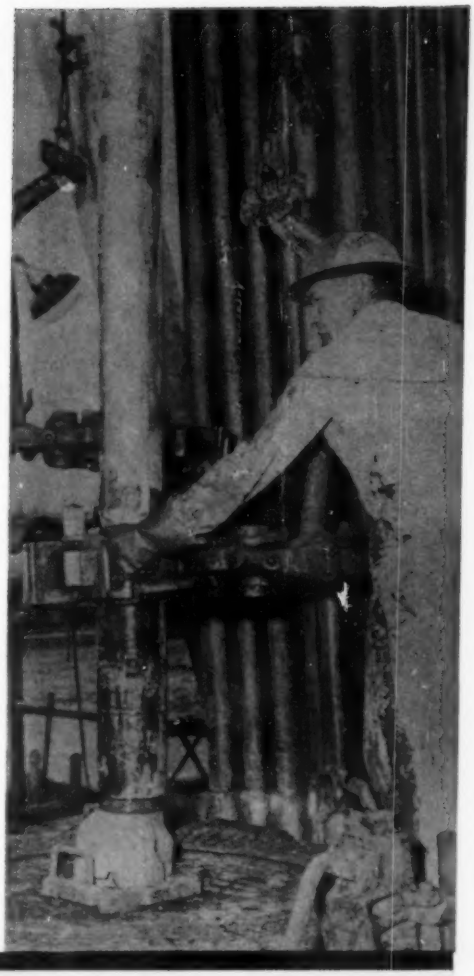
Servco Drill Collars are made from K-Monel – the only material guaranteed to stay non-magnetic

Eliminate any chance of magnetic influence on directional survey compasses.

Why take chances with the accuracy of your directional surveys by using drill collars that can become magnetic from normal use? Tests show survey compasses can be deflected as much as 3° when magnetic permeability of the drill collar is 1.05. A 3° cumulative error in a 45°, 10,000 foot well could result in the bottom of the hole being 370 feet in error.

The magnetic permeability of Servco K-Monel Drill Collars is guaranteed by the manufacturer to be 1.02 or less. And, unlike collars made of other materials, no amount of cold working, change in temperature, storage close to magnetic sources, etc., will boost the magnetic permeability of this unusual metal above 1.02—not much more than the permeability of air!

So why gamble? When you want a *truly accurate* survey, use the one collar you know is *permanently non-magnetic*—Servco K-Monel.



Results of magnetic tests on K-Monel conducted by a United States testing laboratory

Recently five samples of K-Monel were cut from drill collars which had been in service from 2 to 3 years. These samples were sent to a United States laboratory for testing as to their magnetic permeability.

Magnetic permeability of each specimen was obtained at room temperature of about 25°C. by measuring the intrinsic induction at magnetizing forces of 100, 200, and 300 oersteds in a solenoid. The values obtained are given in the adjacent table.

PERMEABILITY

K-Monel—2 to 3 year field usage

Sample	H-100	H-200	H-300
1	1.00_1	1.00_4	1.00_4
2	1.00_5	1.00_5	1.00_5
3	1.00_3	1.00_3	1.00_3
4	1.00_5	1.00_5	1.00_5
5	1.00_2	1.00_3	1.00_3

SUPERIOR MECHANICAL PROPERTIES

Test	15-15 Cr-Ni Stainless Steel	Type 304 Stainless Steel	1040 Carbon Steel	4140 Drill Collar Steel	"K" Monel Metal
Yield Strength, P.S.I.	34,000	35,000	45,000	110,000	110,000
Tensile Strength, P.S.I.	82,000	80,000	70,000	135,000	140,000
Elongation in 2 in., %	48.0	50	30	15.0	22
Reduction in Area, %	54.0	60	59	45.0	54.0
Hardness, Brinell	150	170	143	300	290
Density, lb./cu. in.	0.290	0.290	0.284	0.284	0.306

Send all inquiries to:

©THE SERVCO COMPANY

SERVCO

General Offices: 2440 Cerritos Ave., Long Beach 6, California
Mid-Continent and Gulf Coast: 4850 Gasmer St., Houston 35, Texas
Export Agent: International Tool and Supply Co.
45 Rockefeller Plaza, New York 20, New York

Field Offices: Ventura, Bakersfield, Lafayette, Harvey, Oklahoma City
Canada: 5710 103A Street, Edmonton, Alberta
Venezuela: c/o A-Z Export Co., Maracaibo

GOOD TIME TO TRIM FAT

from needless caustic soda costs!

Columbia-Southern's experience in manufacturing and selling quality caustic soda convinces us that many caustic users can effect appreciable savings on their current costs. Isn't this the ideal time to see if this applies to your caustic consumption?

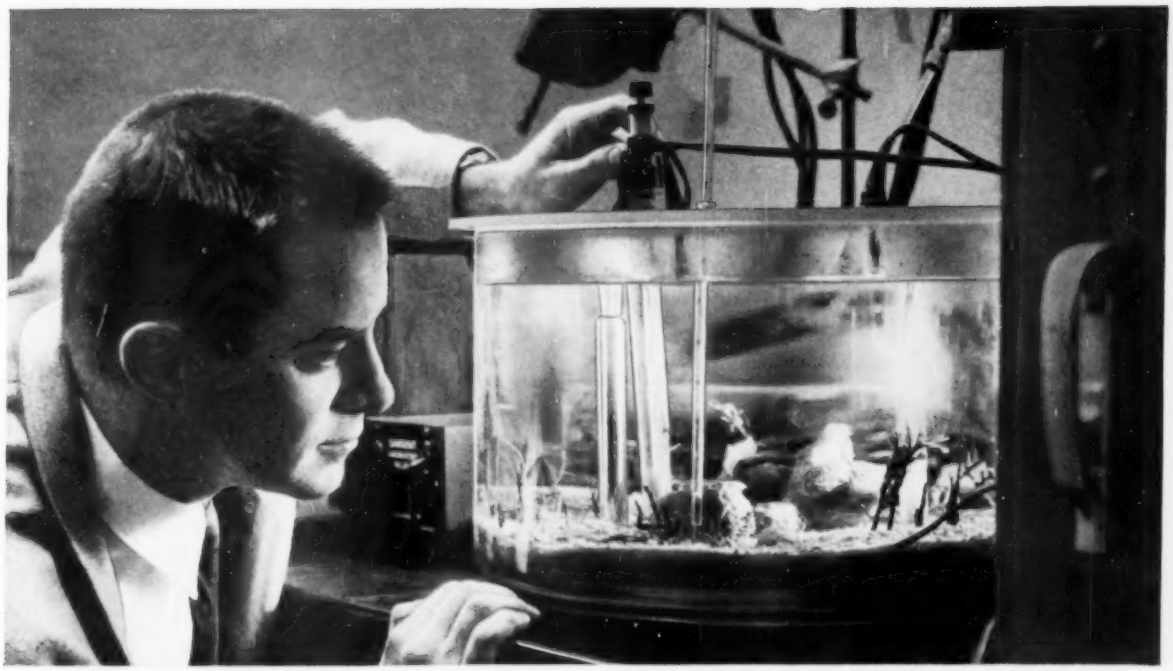
Let's take the *form* of caustic you are buying and handling. Are you quite sure that new or projected changes in your products or processing won't be benefited by purchasing liquid, rather than anhydrous? Or vice versa? Or 73% liquid, rather than 50%? Do you have reliable figures on diluting and storing the stronger concentration? How about the facts on completely up-to date unloading techniques and equipment?

How about the uniform *quality* of the caustic you are receiving? Here again, Columbia-Southern can advise you with the authority of recognized experience. As a matter of record, we have led in developing improved tank car linings, heating, insulation, and safety features . . . patented unloading and dilution processes . . . economical waterways delivery.

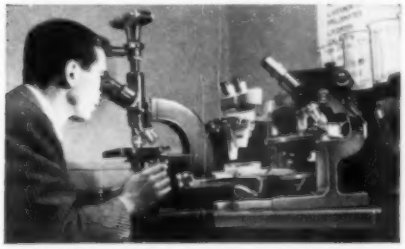
Our well-grounded Technical Service engineers have helped customers save thousands of dollars in buying and using caustic soda. Isn't it good business, especially *now*, to see what savings they might work out for you? You may request their services either through our Pittsburgh address, or any of the fourteen Columbia-Southern District Sales Offices.

The Columbia-Southern Chemical Corporation, One Gateway Center, Pittsburgh 22, Pennsylvania. Offices in principal cities. In Canada: Standard Chemical Limited.

COLUMBIA-SOUTHERN CHEMICAL CORPORATION A Subsidiary of Pittsburgh Plate Glass Company



WHAT CAN A FISH BOWL TELL? The tiny plants and animals that grow in this "fish bowl" will be similar to those that grew in oceans fifty million years ago and more. The aim of this experiment is to add to man's knowledge of where to look for oil deposits. Pictured is Dr. F. G. Stehli.



HAY FEVER SUFFERERS may be interested to know that pollen is helpful—in the search for oil, that is. Here Dr. A. T. Cross studies traces of pollen in rock millions of years old to interpret underground formations. A comparatively new science, this study of ancient pollen opens previously explored areas to new examination.

THE SEARCH FOR OIL goes on in some of the most inaccessible regions in the world. And expensive, specially-built equipment like this "swamp buggy" is needed to overcome the obstacles of nature and to find more new oil every year than is taken out of the ground.

Time turned back 50 million years; Scientists seek new clues to oil!

Tiny marine plants and animals, very like those living when dinosaurs roamed the earth, are being grown today in a research laboratory.

In glass containers similar to fish bowls, scientists of Pan American Petroleum Corporation, a Standard Oil affiliate, have transplanted sand and sea water from an ocean shore line. Then, by controlling temperature, pressure and salt content, they have simulated the environment of plants and animals that grew 50 to 300 million years ago.

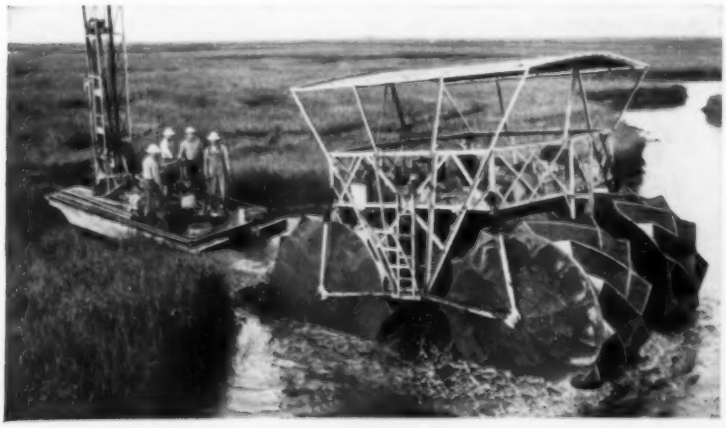
The chemical composition of the microscopic life that grows in the laboratory will offer more positive clues to the type of environment of ancient fossils; that is, whether the tiny animals lived and died in deep, shallow, or protected water.

This knowledge will help scientists to map ancient seas with greater accuracy, to pinpoint the location of prehistoric shore lines and barrier reefs where conditions were ideal for oil to form. Such knowledge will improve our ability to find oil in sufficient quantities to meet today's steadily increasing needs.

This is another example of the way research works at Standard and its affiliates to discover quicker, surer methods of finding oil, to keep the supply up and the price down.

As the result of such trail-blazing research work as the fish bowl project, America's proved underground reserves have grown larger, prices have remained reasonable, and America has been assured of an adequate supply to keep its defenses strong.

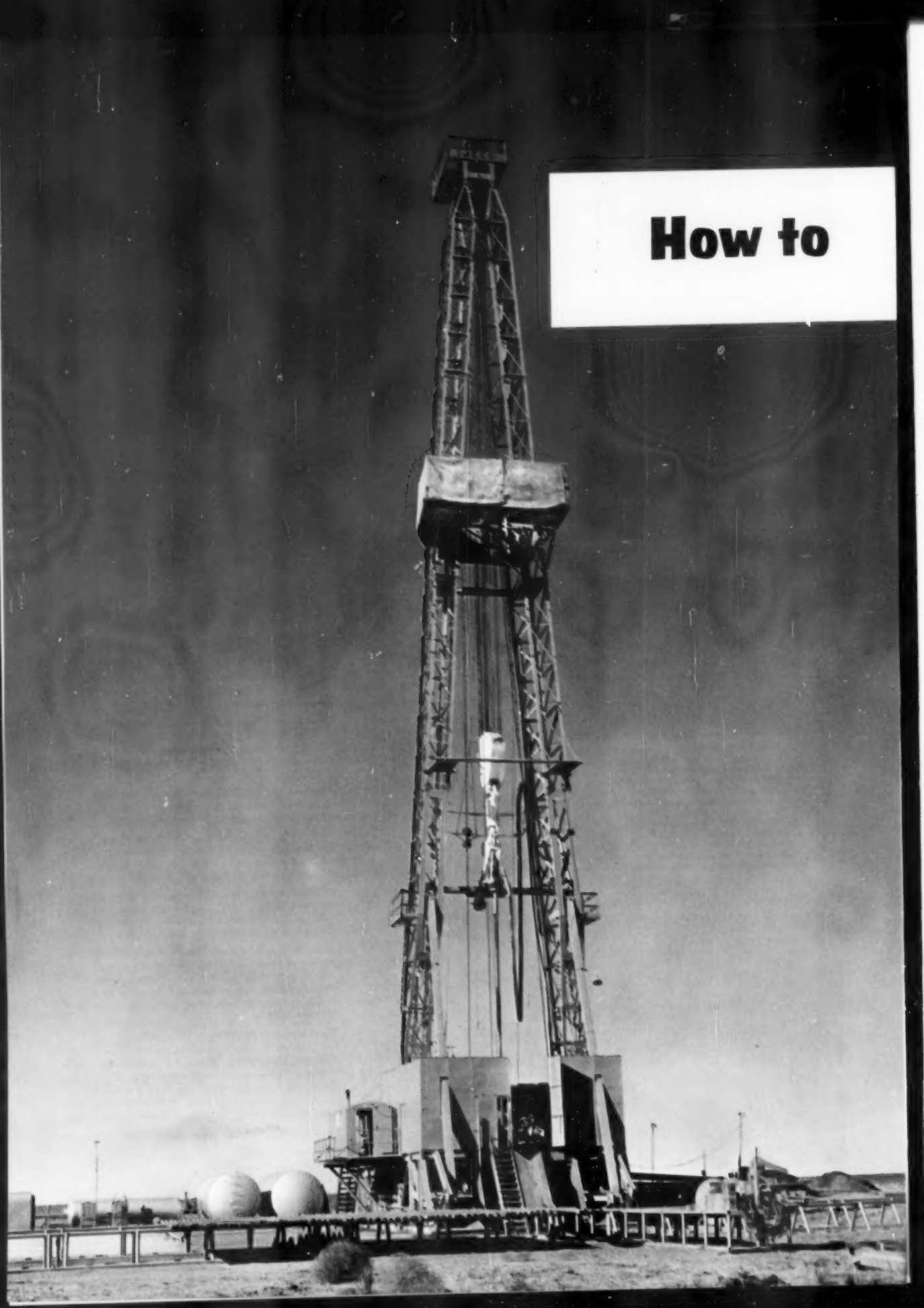
What makes a company a good citizen? One measure is a company's concern for the welfare of future generations. In our business, a "let-tomorrow-take-care-of-itself" attitude would be disastrous. Through research, we at Standard are working to make life more comfortable and secure for all—today and for the future.



STANDARD OIL COMPANY
(INDIANA)

STANDARD

THE SIGN OF PROGRESS...
THROUGH RESEARCH


How to

Drill with Speed and Economy

Foot by foot through any formation you're ahead with quality drilling equipment products from Jones & Laughlin Supply Division. Tough and trouble-free, they dig the world's deepest holes and speed the endless routine jobs that never make headlines. Supporting this quality line is J&L's brand of oil field service, delivering the materials you need when and where you want them.

Here's the best available for drilling with **speed** and **economy**:

Jones & Laughlin Drill Pipe... available in famous Blue Ribbon Vanadium grade for the really tough jobs.

Jones & Laughlin Wire Rope... a proven product supplying longer service life with less downtime.

Gardner-Denver Mud Pumps... set the standards while supplying the power it takes to punch a hole to pay... for profit.

Ideco Rigs... mechanical, electrical or Hydrair ... with the Full View mast.

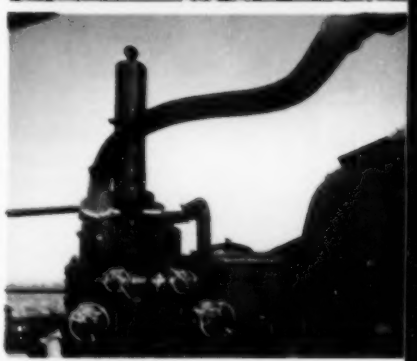
Republic Rotary Hose... with the patented connection, the higher the pressure the tighter the seal.

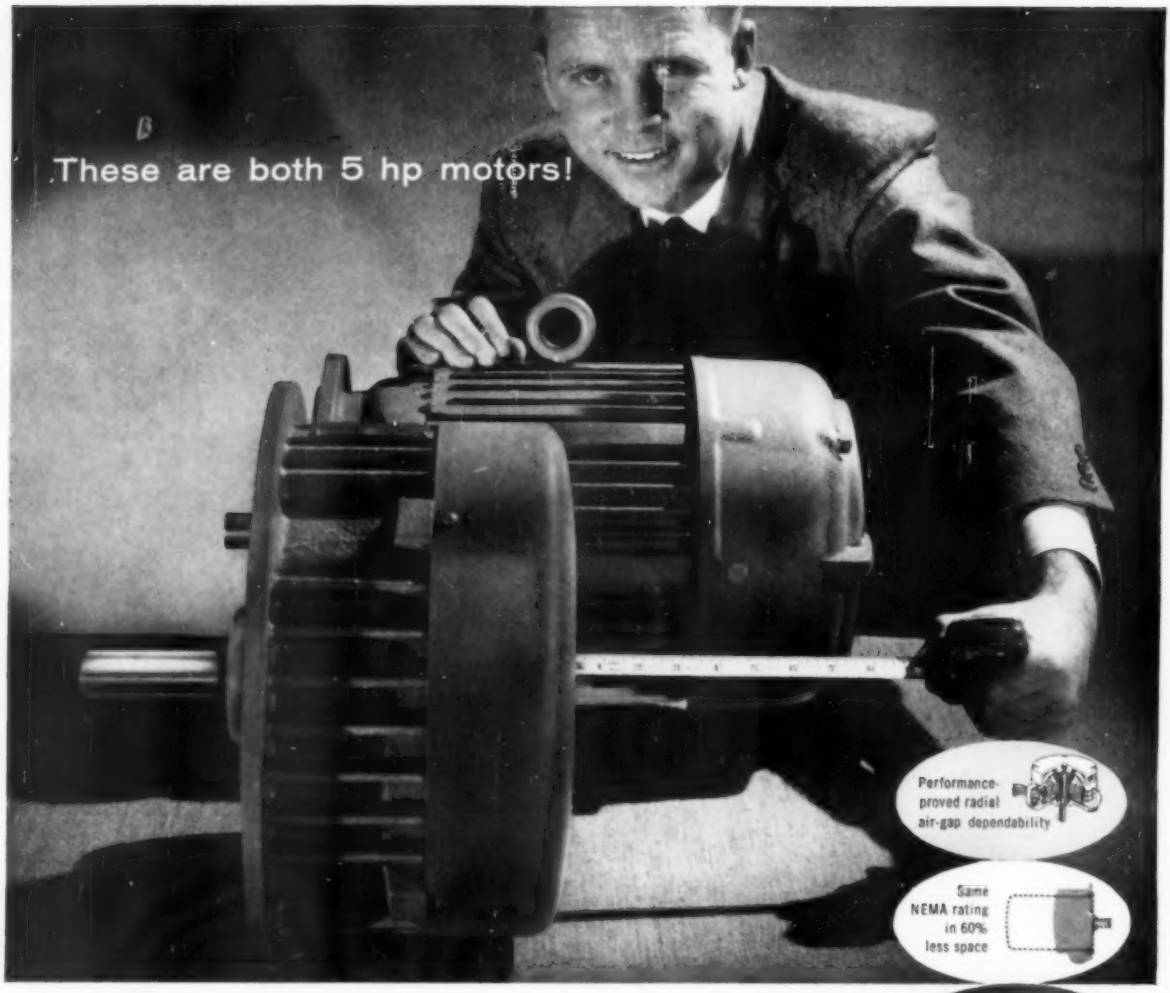
For complete information on these and other oil field supplies contact your local J&L Supply Division man or write us direct, Drawer 2481, Tulsa.

Jones & Laughlin

SUPPLY DIVISION – Tulsa

If it's sold by J&L....
it's the best available





60% shorter– but with radial air-gap design!

New Louis Allis Pancake Motor preserves all the advantages of conventional motor construction

The new Louis Allis Pancake Motor is your solution to trouble-free power in any space-cramped motor application.

The Pancake is a remarkably short flange-mounted motor — up to 60% shorter and 33% lighter than standard motors of the same rating! And it is built in *conventional* radial air-gap design!

It's done by an ingenious forming process which literally compresses the end coils of a conventional radial air-gap motor into an exceptionally short length. The result is a compact, light motor ideally suited for horizontal or vertical mounting on machine tools, roof ventilating fans, or *any* close-quarter installation where space is a critical design factor.

What's more, this is achieved without sacrificing a single desirable characteristic: the stator still contains the same iron and copper as standard Louis Allis motors . . . standard NEMA service factor is maintained . . . high insulative values are retained by using proved Louis Allis varnishes and new insulating techniques . . . over-sized pre-lubricated bearings are used to guarantee long bearing life . . . and the entire motor is enclosed in an industrial-type cast-iron housing designed to shrug off abuse!

The housing and flange are cast in one piece: this permits extra-accurate internal machining which extends bearing life and reduces noise levels to a new low.

Investigate the Pancake Motor through your local Louis Allis District Office. Sized from 1 to 15 hp, at 1800, 1200, and 900 rpm, in open drip-proof and enclosed non-ventilated or fan-cooled enclosures. Write for Bulletins 2100 and 2150 to the Louis Allis Co., 449 E. Stewart St., Milwaukee 1, Wis.

SM-101

LOUIS ALLIS

MANUFACTURER OF ELECTRIC MOTORS AND ADJUSTABLE SPEED DRIVES

FIELD FACTS

Up from the Briny

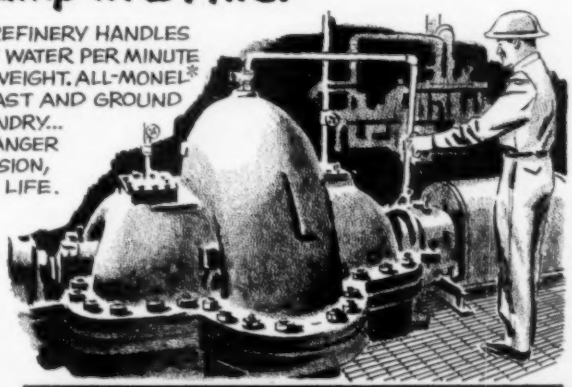
TO AID SALT WATER CORROSION RESEARCH

PARTS FROM THE "FANNIE AND JENNIE", CONFEDERATE BLOCKADE RUNNER SUNK 1864...RECENTLY RECOVERED ...CONTRIBUTE DATA TO INCO'S CONTINUING RESEARCH PROGRAM ON SALT WATER CORROSION. DECADES OF TESTING HAVE GIVEN INCO VAST DATA ON CORROSION RESISTANCE OF MATERIALS. PROGRAM PAVES WAY FOR IMPORTANT OIL FIELD APPLICATIONS ...TWO TYPICAL EXAMPLES BELOW.

CONFEDERATE BLOCKADE RUNNER, "FANNIE AND JENNIE"

62,000 tons of salt go through pump in 24 hrs.

PUMP IN NEW JERSEY REFINERY HANDLES 40,000 GALLONS OF SALT WATER PER MINUTE ...SALT 35 PARTS/1000 BY WEIGHT. ALL-MONEL* 2200-LB. IMPELLER.... CAST AND GROUND AT INCO'S BAYONNE FOUNDRY... FIGHTS OFF CONSTANT DANGER OF SALT WATER CORROSION, ASSURES LONG SERVICE LIFE.



20,000 ft. down at 400°F plus... clock has split-second accuracy

CLOCK'S ACCURACY VITAL TO EFFICIENCY OF HOWCO PRESSURE RECORDER. CLOCK ACTIVATES DRUM CHART...RECORDS PRESSURE VARIATIONS VS. TIME. THAT'S WHY HOWCO USES CLOCK PARTS OF MONEL ALLOY. THIS ALLOY'S CORROSION RESISTANCE, TOUGHNESS, EXCELLENT WEAR AND THERMAL EXPANSION CHARACTERISTICS PROTECT ACCURACY IN SOUREST WELL, DURING ROUGHEST TREATMENT, THROUGH TEMPERATURE VARIATIONS FROM ATMOSPHERIC TO OVER 400°F.

DO YOU HAVE A METAL PROBLEM?

THERE'S A GOOD CHANCE INCO'S DEVELOPMENT AND RESEARCH DIVISION HAS SOLVED A SIMILAR ONE OR HAS COME CLOSE ENOUGH TO IT TO SUGGEST A PRACTICAL ANSWER. JUST LET US KNOW DETAILS.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street — New York 5, N. Y.

INCO

*Registered trademark

INCO NICKEL ALLOYS

SAVE money

SAVE maintenance

SAVE with Electrical Developments

SAVE manpower

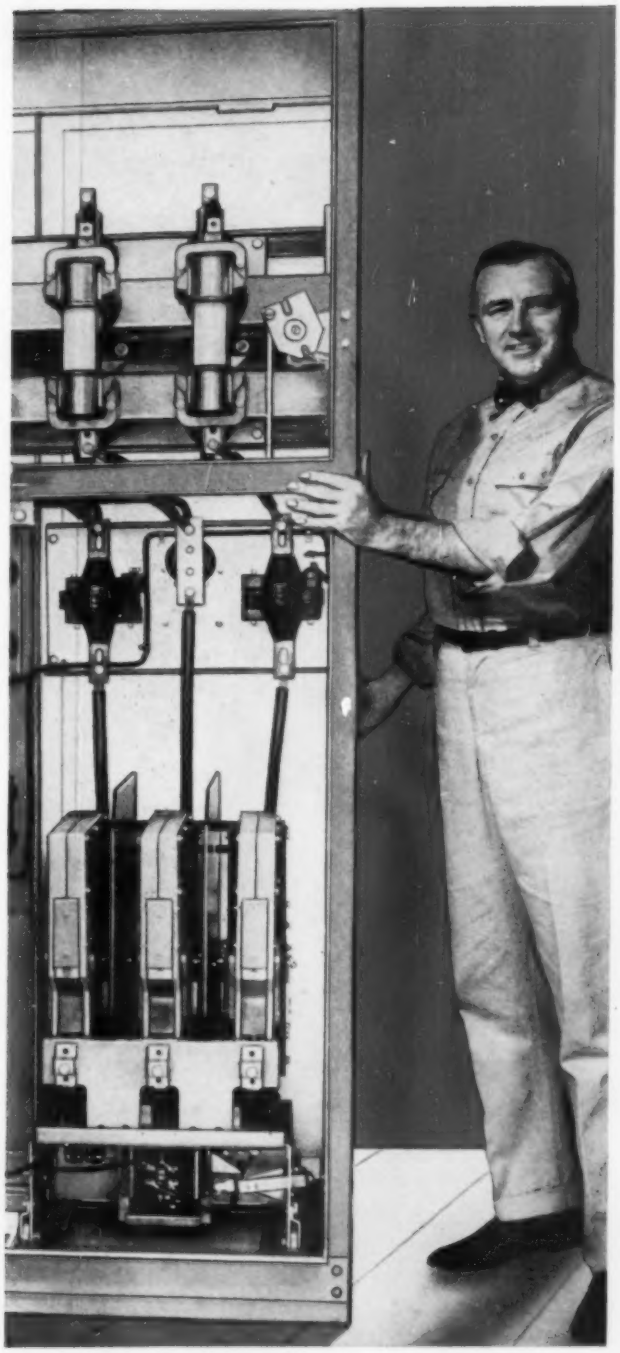
New ideas with Electric Power such as this submerged aerator provides multi-savings

Through use of the 50HP 440 Volt Motor, above, operating a blower for the submerged aerator, shown right, this user of Utility Power achieved more positive aeration, saved investment of large open lined pond and saved on water loss by eliminating spray action. This is typical of the adaptability and savings of low-cost Electric Power. For more information on how you can save call your local Utility Electric Power Company or write us.

Purchased Electric Power . . saves money, manpower, maintenance and serves you better automatically

Petroleum Electric Power Association

P.O. BOX 35006, DALLAS 35, TEXAS

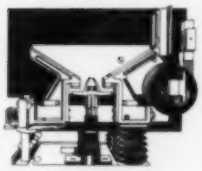


Tough high-voltage job?...Here's the answer!

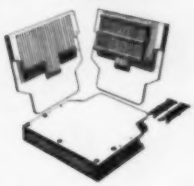
Allen-Bradley High-Voltage Air Break Starters are ideal for frequent switching, reversing, plugging, or jogging.

A tremendous operating life has been built into these high-voltage air break starters . . . resulting from the use of the simple solenoid contactor. It's the same design—having only ONE moving part—that provides millions of trouble free operations in Allen-Bradley's low-voltage controls. These starters are made in a complete line for all types of service. Send for Publication 6080, today.

ONLY ONE MOVING PART
With this simple solenoid design, all trouble causing pivots, pins, and flexible jumpers are eliminated. Straight up-and-down motion of contactor is virtually frictionless.



DOUBLE BREAK CONTACTS
Allen-Bradley silver alloy contacts never need maintenance . . . they remain in perfect operating condition until completely worn away. Vertical motion assures uniform contact pressures at all times.



FASTER ARC SUPPRESSION
The air break contactor employs a completely different blowout design and novel arc chute which assure rapid arc extinction. Chutes are molded from arc resistant material.

A-B QUALITY

ALLEN-BRADLEY

QUALITY

MOTOR CONTROL

Allen-Bradley Co., 1304 S. Second St., Milwaukee 4, Wis. • In Canada: Allen-Bradley Canada Ltd., Galt, Ontario

Howard Williams, driller, says, "We've had no trouble with Tiger Brand Lines—they've got the stuff to last."

Helmerick & Payne Rig No. 38 drilling with 7500 feet of Tiger Brand Rotary Drilling Line.

"We get better service from this wire rope than any other make,"

says **Howard Williams,** driller from Helmerick & Payne, Inc.

—It's Tiger Brand, of course

This rig was drilling in Garvin County, Oklahoma, when these photographs were taken. They were using a 7500-foot, 1¼" 6 x 19 USS American Tiger Brand Rotary Drilling Line with wire core.

This is the line that has set some of the highest ton-mile records in the oil fields. The driller, Mr. Howard Williams, said, "We've had better service with American Tiger Brand than with any other rope we ever used. It spools easy and we seldom have to add lubrication."

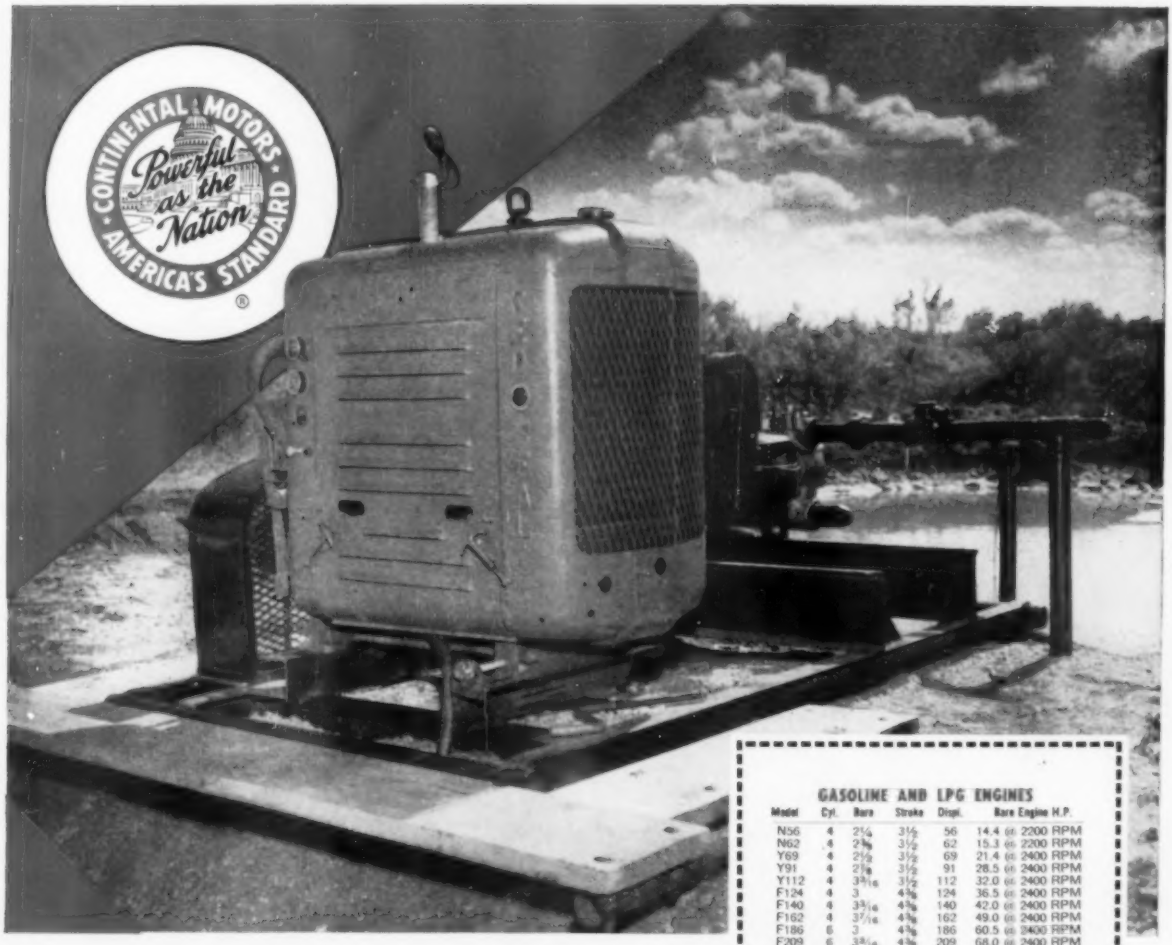
Helmerick & Payne, Inc. have used Tiger Brand Rope for many years. They operate more than twenty rigs. By following recommended cut-off practices and taking proper care of the rope, they get maximum service and low wire rope costs.

You can get USS American Tiger Brand Wire Rope from leading distributors throughout the oil fields. Try it next time. You'll save money.

USS and Tiger Brand are registered trademarks

American Steel & Wire Division of USS **United States Steel**

Columbia-Geneva Steel, San Francisco • United States Steel Export Company, Distributors Abroad



CONTINENTAL RED SEALS
Find Ready Acceptance in the Oil Fields

The ever-widening acceptance of Continental Red Seal engines in all types of oil field operations is attributed in great part to specialization —in Continental's long-standing policy of engineering each model precisely to the job to be done. Each and every model is the product of 56 years' engine-building experience. The industrial series comprises 57 different basic models—from 14 to 237 horsepower and they are backed by parts and service from coast to coast. Visit your nearest oil field supply store or write the factory for information.

6 EAST 45TH ST., NEW YORK 17, NEW YORK • 3817 S. SANTA FE AVE., LOS ANGELES 58, CALIF.
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Continental Motors Corporation
MUSKEGON • MICHIGAN

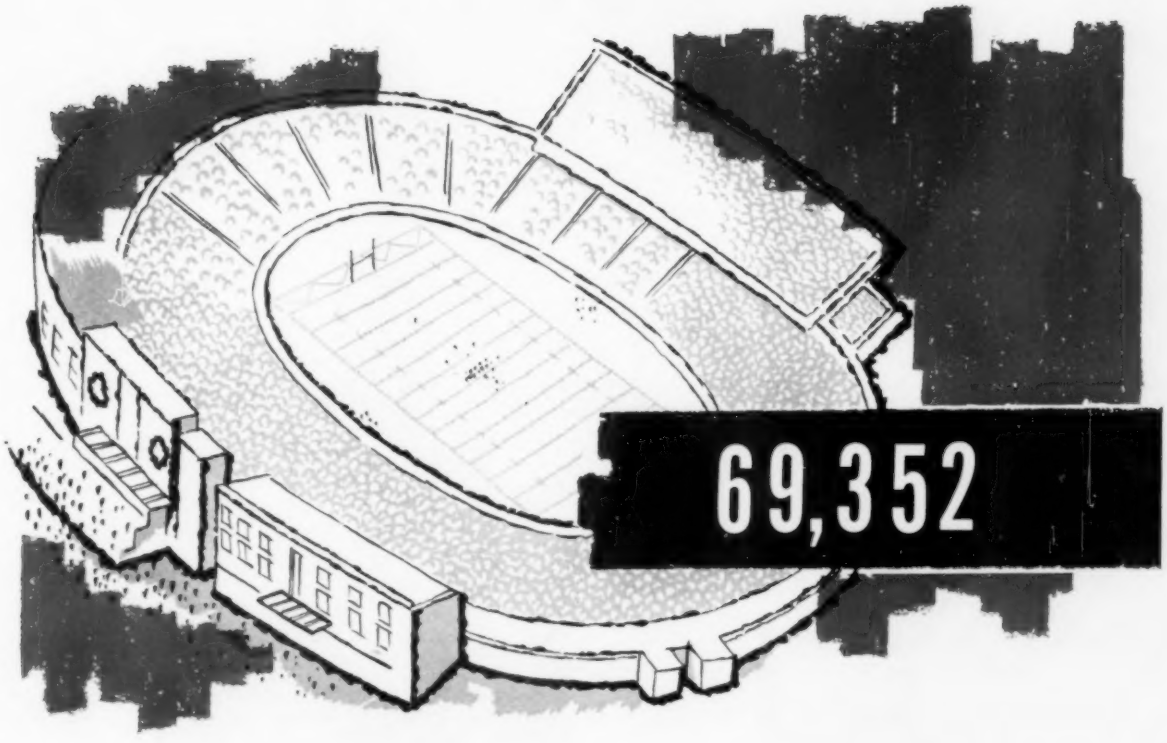
GASOLINE AND LPG ENGINES

Model	Cyl.	Bore	Stroke	Displ.	Bare Engine H.P.
N56	4	2¼	3½	56	14.4 @ 2200 RPM
N62	4	2⅜	3½	62	15.3 @ 2200 RPM
Y69	4	2½	3½	69	21.4 @ 2400 RPM
Y91	4	2⅞	3½	91	28.5 @ 2400 RPM
Y112	4	3 1/16	3½	112	32.0 @ 2400 RPM
F124	4	3	4⅜	124	36.5 @ 2400 RPM
F140	4	3 1/16	4⅜	140	42.0 @ 2400 RPM
F162	4	3 7/16	4⅜	162	49.0 @ 2400 RPM
F186	6	3	4⅜	186	60.5 @ 2400 RPM
F209	6	3 1/16	4⅜	209	68.0 @ 2400 RPM
F226	6	3 3/16	4⅜	226	73.0 @ 2400 RPM
F244	6	3 7/16	4⅜	244	79.0 @ 2400 RPM
M271	6	3⅝	4⅜	271	86.2 @ 2400 RPM
M290	6	3¾	4⅜	290	92.2 @ 2400 RPM
M330	6	4	4⅜	330	104.4 @ 2400 RPM
M363	6	4	4 11/16	363	128.9 @ 2800 RPM
B371	6	4 1/16	4⅝	371	110.0 @ 2400 RPM
B427	6	4 5/16	4⅝	427	127.0 @ 2400 RPM
*Z129	4	3¼	3⅝	129	35.0 @ 2000 RPM
*Z134	4	3 1/16	3⅝	134	39.5 @ 2000 RPM
G134	4	3¼	4⅜	134	35.0 @ 2000 RPM
G157	4	3⅜	4⅜	157	40.0 @ 2000 RPM
*G174	4	3 9/16	4⅜	174	54.0 @ 2000 RPM
*G193	4	3¾	4⅜	193	59.4 @ 2000 RPM
*E201	4	3⅝	4⅞	201	65.9 @ 2400 RPM
*E208	4	3 11/16	4⅞	208	67.8 @ 2400 RPM
H227	4	3⅝	5½	227	54.0 @ 1800 RPM
H243	4	3¾	5½	243	57.9 @ 1800 RPM
*H260	4	3 15/16	5½	260	62.0 @ 1800 RPM
*H277	4	4	5½	277	66.1 @ 1800 RPM
K363	6	4	4 11/16	363	123.0 @ 2400 RPM
*J382	4	4½	6	382	74.0 @ 1400 RPM
*U403	4	4⅝	6	403	110.0 @ 2000 RPM
T371	6	4⅛	4⅝	371	119.0 @ 2400 RPM
T427	6	4 5/16	4⅞	427	140.0 @ 2400 RPM
U501	6	4½	5¼	501	160.0 @ 2400 RPM
R513	6	4½	5⅝	513	164.3 @ 2400 RPM
R572	6	4⅝	5⅝	572	182.4 @ 2400 RPM
R602	6	4⅝	5⅝	602	191.7 @ 2400 RPM
V603	8	4⅛	4¼	603	240.0 @ 2800 RPM
S749	6	5⅝	5½	749	217.0 @ 2200 RPM
S820	6	5⅝	5½	820	237.0 @ 2200 RPM

CUSHIONED POWER DIESEL ENGINES

Model	Cyl.	Bore	Stroke	Displ.	Bare Engine H.P.
*ZD129	4	3¼	3⅝	129	34.0 @ 2000 RPM
GD157	4	3⅜	4⅜	157	39.0 @ 2000 RPM
*GD174	4	3 9/16	4⅜	174	42.5 @ 2000 RPM
*GD193	4	3¾	4⅜	193	55.5 @ 2200 RPM
*ED201	4	3⅝	4⅞	201	45.8 @ 2000 RPM
*ED208	4	3 11/16	4⅞	208	61.5 @ 2200 RPM
HD243	4	3¾	5½	243	68.9 @ 2200 RPM
*HD260	4	3 15/16	5½	260	74.0 @ 2400 RPM
*HD277	4	4	5½	277	79.0 @ 2400 RPM
*JD382	4	4½	6	382	87.4 @ 2000 RPM
*UD403	4	4⅝	6	403	91.5 @ 2000 RPM
TD427	6	4 5/16	4⅞	427	132.0 @ 2200 RPM
RD572	6	4⅝	5⅝	572	154.0 @ 2000 RPM
VD603	8	4⅛	4¼	603	197.0 @ 2600 RPM
SD802	6	5 5/16	5½	802	202.0 @ 1800 RPM

*Available for industrial applications only.



. . . Almost enough to fill the Cotton Bowl

That's the number of injured workmen who received medical aid and compensation benefits from Texas Employers' in 1957.

Of course, the thousands who were *not* injured because of the intense safety efforts of TEIA and its policyholders would fill many Cotton Bowls.

But when accidents do occur, it's doubly gratifying to know that your insurance carrier has trained and experienced men in 25 Texas offices who have the desire to handle your claims fairly and promptly.

This service is one of the principal reasons why TEIA writes more workmen's compensation insurance in Texas than any other *five* companies combined. Why not put this service to work for you? Call your nearest Texas Employers' office today.

TEXAS EMPLOYERS
INSURANCE ASSOCIATION

HOME OFFICE:
EMPLOYERS INSURANCE BUILDING
DALLAS, TEXAS

AUSTIN F. ALLEN, *Chairman of the Board* BEN H. MITCHELL, *President*

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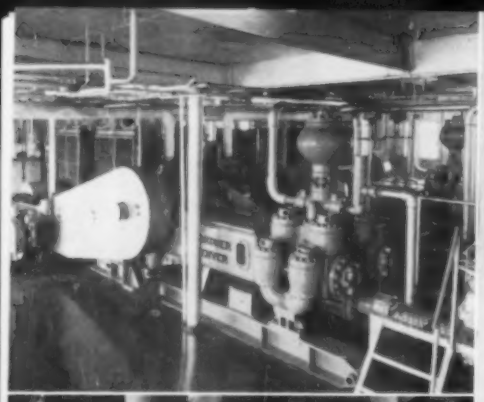
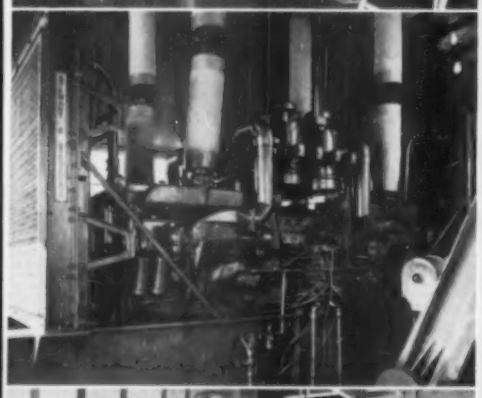
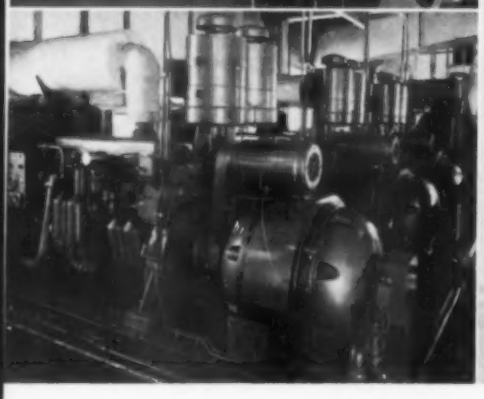
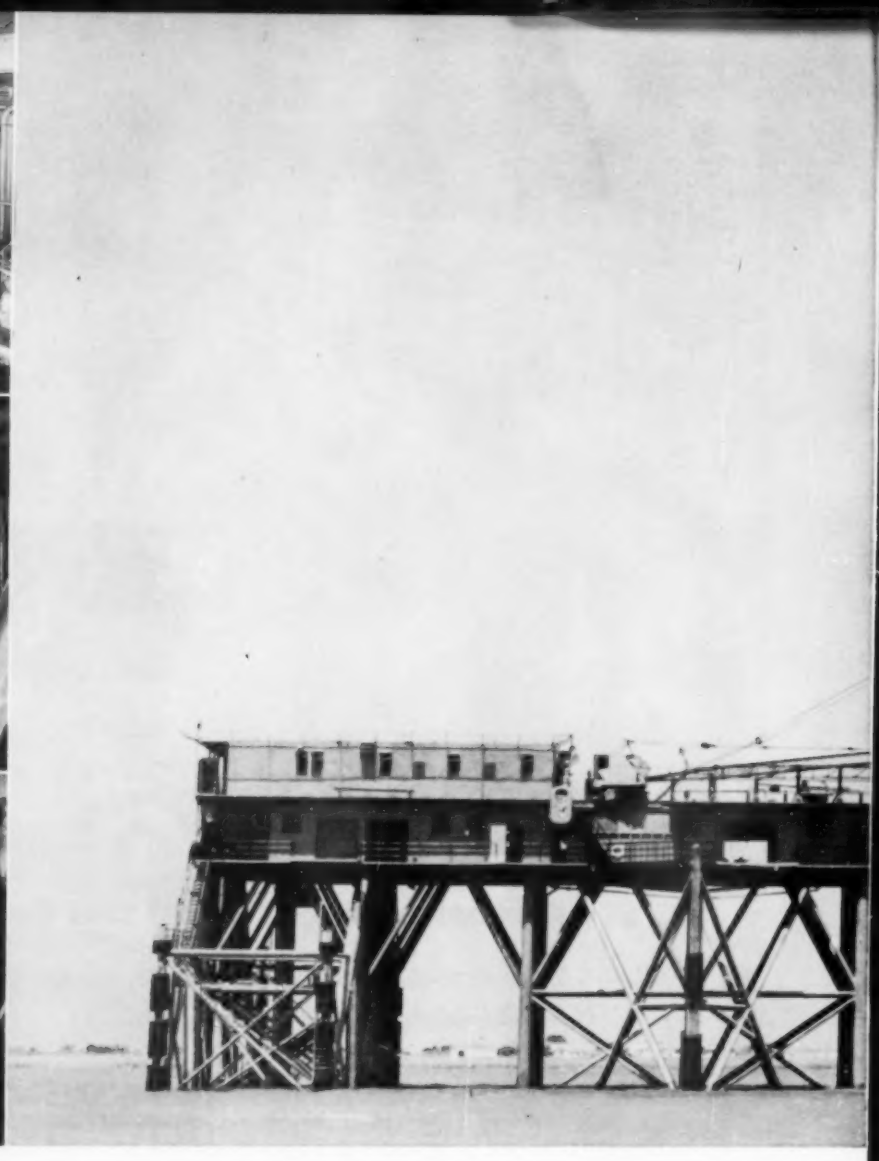
ARTHUR • SAN ANGELO • SAN
ANTONIO • SHERMAN • TYLER
WACO • WICHITA FALLS









RIMROCK TIDELANDS, INC. has selected GM Diesel Power

FOR FOUR NEW RIGS

1

Rimrock Tidelands Rig #3 Powered by two Model S-24-1000 Stewart & Stevenson RIGELECTRIC Quad Power Packages, developing 2000 combined HP. Auxiliaries consist of two S & S Model 110 GD-100, 100 KW AC Generator Sets and one Model 6-110 Power Unit.

2

Rimrock Tidelands Rig #15 Powered by two Stewart & Stevenson Model S-24-2406 Quad 110 Power Units, developing 2000 combined HP. Auxiliaries consist of two S & S Model 110 GD-110, 100 KW AC Generator Sets.

More than two years ago, Rimrock Tidelands launched a bold, new off-shore drilling program.

Dependable power was a major consideration.

To achieve versatility with maximum dependability, which is of prime importance in off-shore drilling, Rimrock's management selected Stewart & Stevenson multiple engined power packages.

Since the commissioning of Rig #3, three additiaonal off-shore rigs have been placed in service. All four, including the mammoth new RIMTIDE which features more than 3500 horsepower, have been powered with General Motors Diesel Engines by Stewart & Stevenson Services.

If you have a power problem . . . whether it is unusual, particularly difficult or just routine . . . why not draw on the experience of the world's largest distributor of diesel engines.

STEWART & STEVENSON SERVICES, INC.

Main Office and Plant:	4516 Harrisburg Blvd., Houston 11, Texas
Branches:	Phone CApitol 5-5341 Corpus Christi, Dallas, Lubbock, San Juan, San Antonio, Beaumont, Odessa
Representatives:	Longview, Brownsville, Wichita Falls, Freeport
Export:	Room 1405, 74 Trinity Place, New York, N. Y.

STEWART & STEVENSON

from Stewart & Stevenson

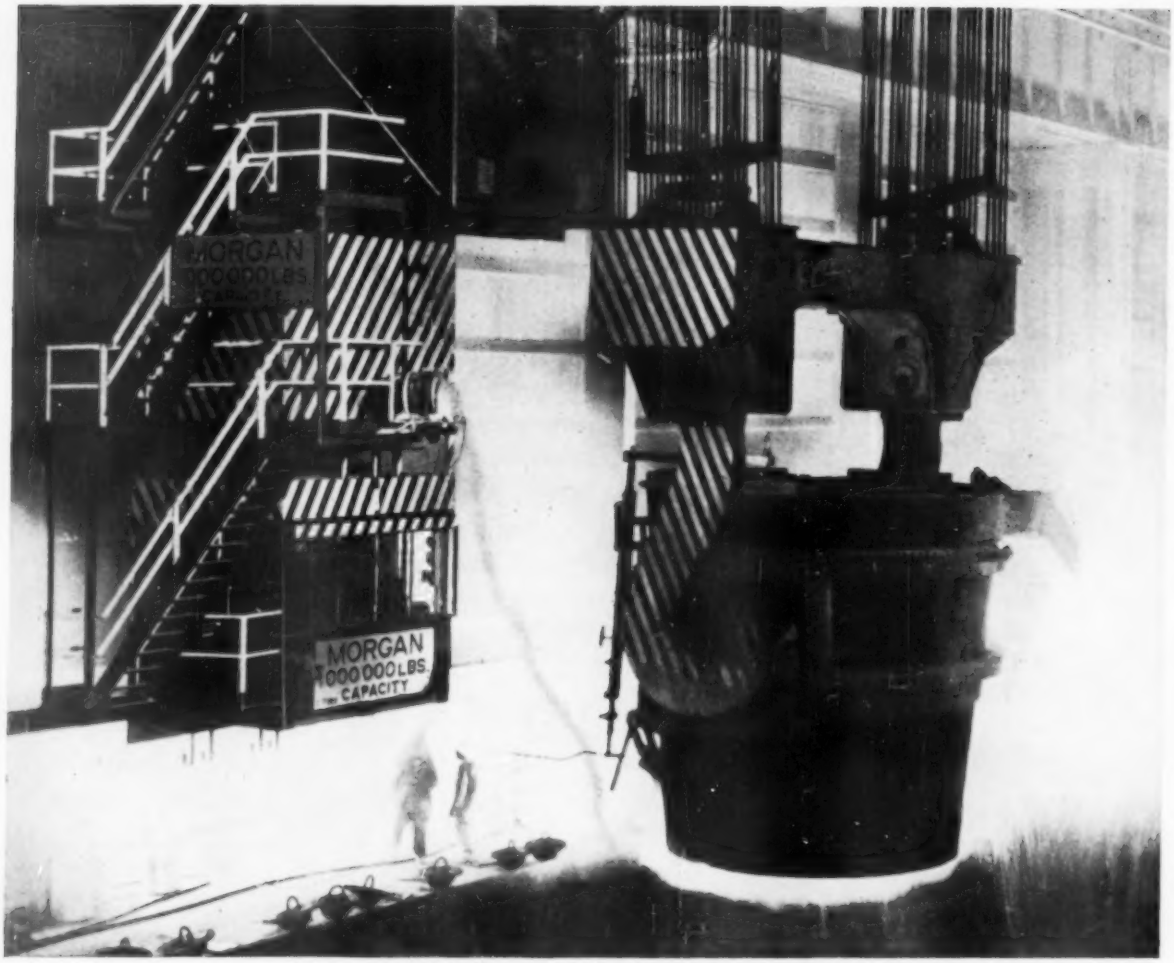
IN A ROW

3

Rimrock Tidelands Rig #14 Powered by two Stewart & Stevenson S-24-2406 Quad 110 Power Units, developing 2000 combined HP. Auxiliaries consist of two S & S Model 110 GD-110, 100 KW AC Generator Sets.

4

The RIMTIDE is the newest member of the Rimrock Tidelands family of offshore drilling rigs. Powered by three Model S-24-2406 S & S model 6-110 Quads and one Model 12-2406 GM Twin 110 Diesel Engines, developing 3500 combined HP. Auxiliaries of three S & S model 110 GD-100, explosion resistant, 100 KW AC Generator Sets and one Model 6-110 GM Power Unit.



Repeated million-pound loads in the intense heat from 375 tons of molten steel, cause no spalling or deformation of Rollway Bearings.

1,122,000 Pounds Ride on 68 Rollway Bearings

One of the largest in the world, this 500-ton Morgan-built ladle crane is Rollway equipped in many positions.

Sixty-eight maximum-type, solid-cylindrical bearings—mounted without inner races—lift and lower the 1,122,000-pound weight of the lifting beam, ladle hooks, ladle and white-hot steel.

Rollway Tru-Rol® type bearings are used in the two General Electric 360 HP – MD-620 Hoist motors which lift the weight of the ladle and its molten metal content.

The maximum-type bearings in the hoisting sheaves are mounted directly on the shaft without inner races, which greatly simplifies assembly for applications of this size.

Thrust bearings in the 25-ton and 75-ton auxiliary crane hooks are standard Rollway precision types with broad-area contact between rollers and plates to prevent Brinelling and assure freedom of rotation under the heaviest loads.

Sheaves ready for assembly on shaft and installation in lifting beam.

For bearings that accomplish the extraordinary in an ordinary manner, write, wire or 'phone Rollway Bearing Co., Syracuse 1, N.Y.

ROLLWAY®
BEARINGS

ENGINEERING OFFICES: Syracuse • Boston • Chicago • Detroit • Toronto • Pittsburgh • Cleveland • Seattle • Houston • Philadelphia • Los Angeles • San Francisco

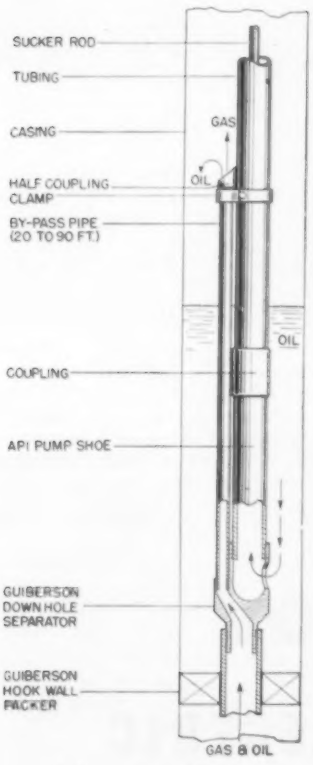
Answer To An Old Problem!

DOWN HOLE SEPARATOR

for pumping wells

Down Hole Separator

The Guiberson down hole separator increases production and eliminates the problem of gas locks, etc., in pumping wells where the produced fluid has a high gas/oil ratio. Less than a foot in length, the separator is screwed directly into a Guiberson packer and the pump shoe fitted directly onto the separator. One to four joints of by-pass pipe, depending upon the producing characteristics of the well, are screwed into the separator and clamped to the tubing. Attached to the top of the by-pass pipe is a half-coupling cut on a diagonal which guides the unit past casing joints. By-pass pipe hugs the tubing as snugly as couplings permit. Production crosses over from the tubing below the packer into the annulus above it and is carried well above the pump shoe by the by-pass pipe. The large annulus above the packer allows the gas to break out of solution and the oil drops back to the large reservoir above the packer where it is picked up by the pump, comparatively free of gas. The separated gas is bled off of the casing continuously. Intake ports on the separator have a larger by-pass area than the tubing. The separator is precision machined from cast steel.



Schematic Installation

ENGINEERING DATA

Part Number	Minimum Casing O.D.	Tubing Size And By-Pass	Maximum Metal O.D.	Approximate Weight	Approximate Length
29439	4½″	2″ x ½″	3¾″	12#	13¾″
29133	5″	2″ x ½″	4⅛″	14#	10½″
28369	5½″	2″ x ¾″	4½″	15#	10⅜″
28645	5½″	2″ x 1″	4½″	15#	10⅜″
29606	5½″	2½″ x ¾″	4½″	15#	16″
28370	7″	2½″ x 1″	5⅝″	20#	11⅛″

Note: The 4½″ x 2″ and 5½″ x 2½″ sizes have NUE 10 round top and EUE 8 round bottom field connections; all other sizes are EUE 8 round both ends. When ordering specify part number, casing, tubing and by-pass size.

BETTER BE SAFE THAN SORRY
GUIBERSON

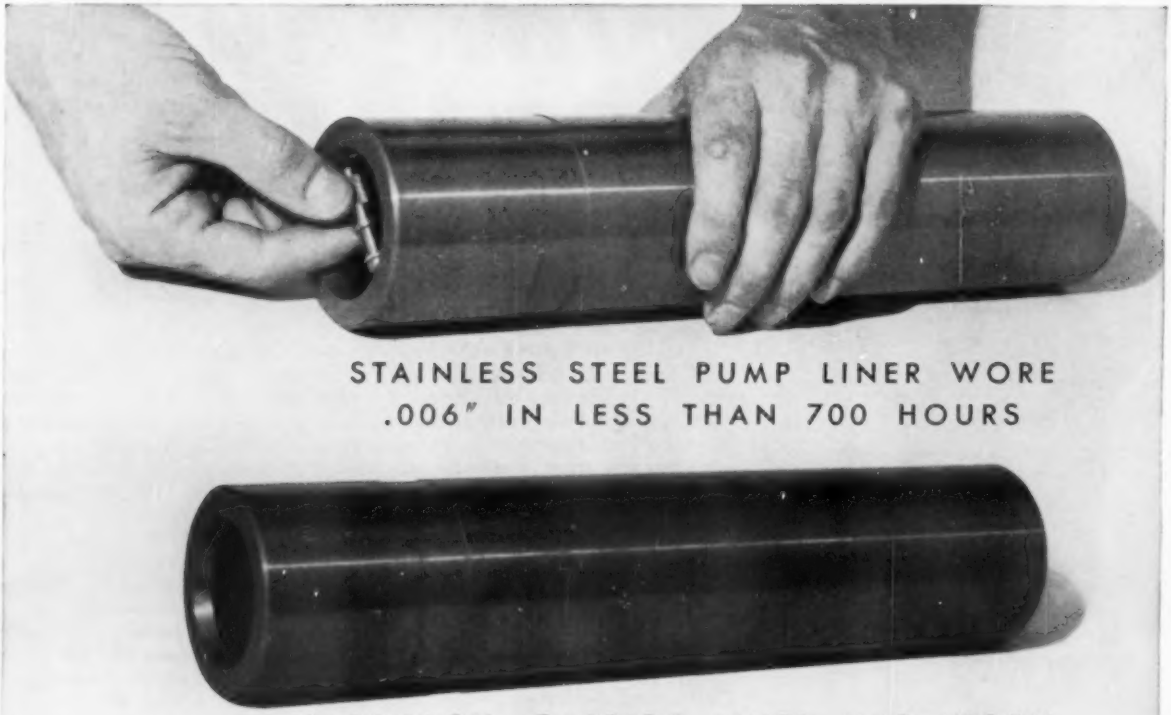
THE
GUIBERSON
CORPORATION

ESTABLISHED 1919
DALLAS, TEXAS
U. S. A.

ONE OF THE DRESSER INDUSTRIES

Sold by
Oil Field Supply Stores
Everywhere

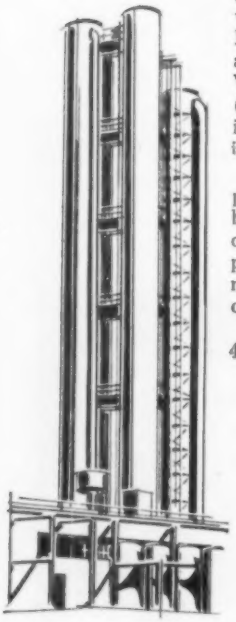
Increase the service life of Petro-Chemical Pumps 20 times



STAINLESS STEEL PUMP LINER WORE .006" IN LESS THAN 700 HOURS

CARBOLOY® CARBIDE LINER HAD WORN ONLY .001" AFTER 12,000 HOURS

Pump liners courtesy of McCartney Manufacturing Co., Inc., Baxter Springs, Kansas



Stainless steel liners, like that shown above, were used in piston and plunger-type pumps. But they required reringing every 150 hours and had to be replaced after 500-700 hours. With Carboloy cemented carbide liners (13⅞" x 2 1/16" ID x 3" OD) service life was increased 20 times . . . and costly reringing is reduced to a minimum.

Another problem had been leakage in plunger-type proportional pumps caused by abrasive liquids scoring the plunger. In one case, pumps working in excess of 25,000 psi had steel and Stellite plungers. Packing needed constant tightening, and complete overhaul was necessary every 30 days.

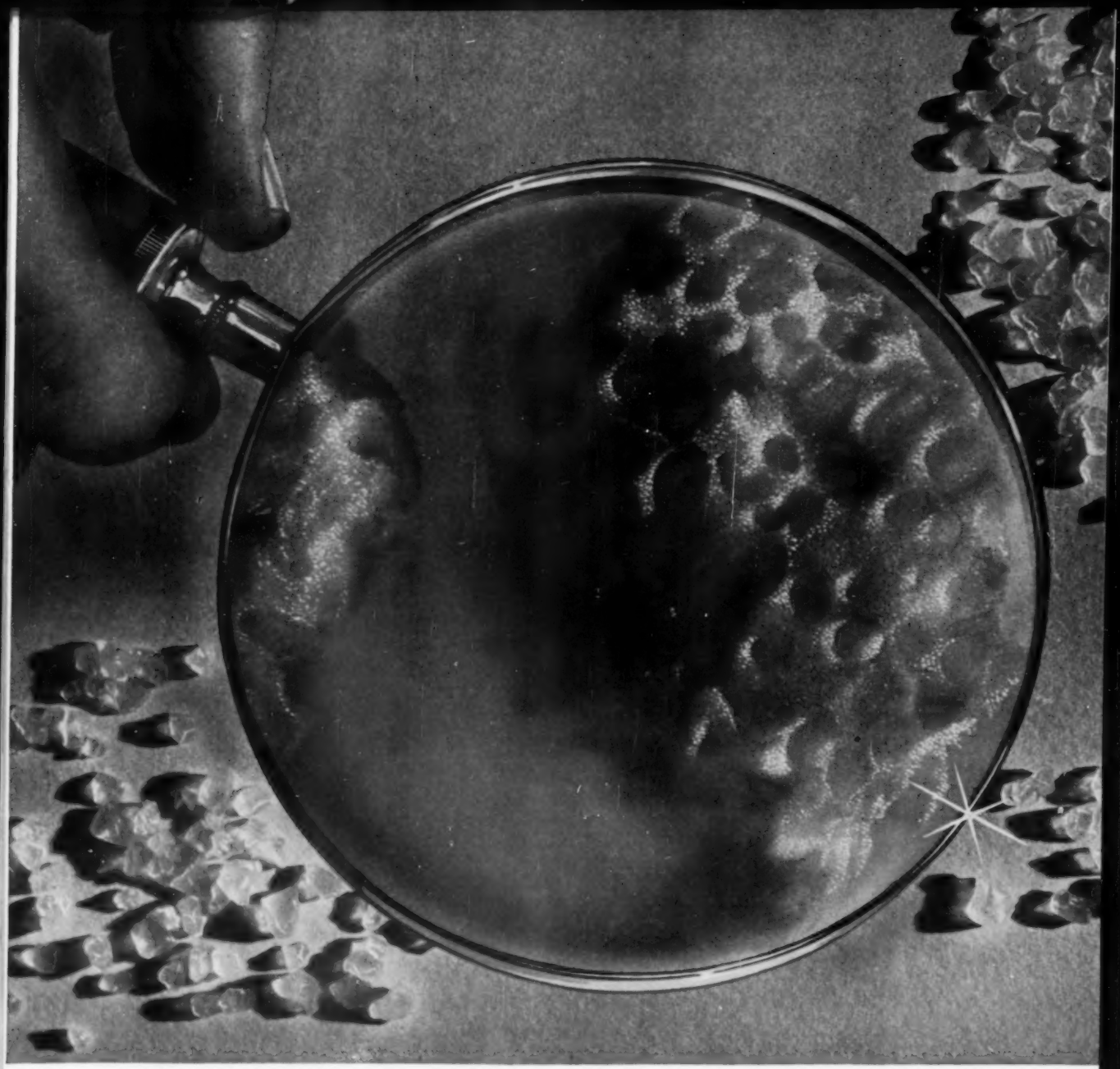
Carboloy carbide plungers with a finish of 4 RMS or better in the packing area were tried. After 3 months, there was no indication of packing leakage, and these plungers are still in use after 2 years.

Carboloy cemented carbide is harder than hardest steel. It takes a high polish and resists the corrosive action of catalytic slurries and other acid and abrasive conditions. That's why Carboloy cemented carbides deliver such extraordinary service . . . reducing costly maintenance and shutdowns.

For more information on how Carboloy cemented carbides can lower your petroleum and petro-chemical costs – or a copy of the new Carbide Engineering Book (WR-111) – write: *Metallurgical Products Department of General Electric Company, 11181 E. 8 Mile Ave., Detroit 14, Michigan.*

CARBOLOY®
CEMENTED CARBIDES

GENERAL ELECTRIC



Millions of tiny pores like these make Davison Silica Gel "vapor-thirsty"!

THEY STRONGLY ATTRACT CONDENSABLE VAPORS, HOLD THEM AS LIQUIDS

Is it any wonder that Davison Silica Gel is ideally suited for air and gas dehydration?

One cubic inch of this high capacity adsorbent and desiccant contains pores having a surface area of about 90,000 square feet (roughly the same surface area as the flight decks of two aircraft carriers). Davison Silica Gel can adsorb up to 40% of its weight of moisture at 100% relative humidity. Even when saturated, it remains dry and free flowing.

Davison Silica Gel is specially treated to give optimum resistance to attrition, and promotes rapid dehydration because of its granular shape. High purity (99.70% SiO_2) and chemical inertness contribute to its resistance to fouling.

A variety of particle sizes, densities and adsorptive capacities are available. Each has been developed to meet specific application demands. There is one to suit yours.

W.R. GRACE & CO.
DAVISON CHEMICAL DIVISION
BALTIMORE 3, MARYLAND

another Eastman contribution to saving drilling time and expense

Two cutter badger jet drilling assembly with Eastco Button Stabilizer.

Eastman Badger Jet...

A new deflection tool to save drilling time and expense in soft formations

Named after the fast burrowing badger, this new exclusive Eastman development has been thoroughly tested and proved at Long Beach and along the Gulf Coast. Wherever there are soft formations this new Eastman Badger Jet with its simple, rugged construction and improved orientation will do the deflecting job faster and better... another fine example of Eastman's program .....

... dedicated to progress through advanced engineering ... research ... and service to the Petroleum Industry.

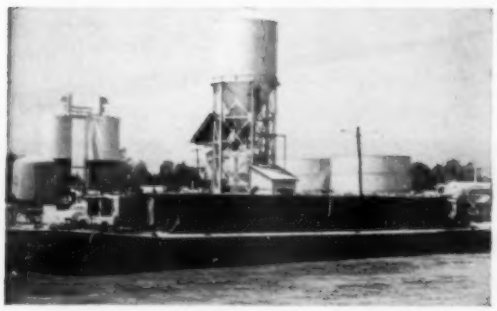
EASTMAN

EASTMAN OIL WELL SURVEY COMPANY
LONG BEACH • DENVER • HOUSTON • CALGARY

For Export Write
EASTMAN INTERNATIONAL DIVISION
P. O. BOX 1500, DENVER 1, COLORADO, U. S. A.

DIRECTIONAL DRILLING • OIL WELL SURVEYING • SIDETRACKING

WE HELP ALL KINDS OF OIL MEN



The men who supply the rig, the men who service it, the men who keep it running are all oil men. They are all in the same business, and they are all a necessary part of it. The Oil and Gas Department at The National Bank of Commerce of Houston has the experience and the know-how to help each kind of oil man.

The Commerce can help you because it knows what it's talking about, and, even more important from your point of view, it knows what *you're* talking about. If you are planning to drill, if you are planning to extend needed services, if you are in the oil business, you'll find that The National Bank of Commerce will help you all the way.

E. O. Buck, *senior vice president, Oil and Gas Department.*

THE NATIONAL BANK OF

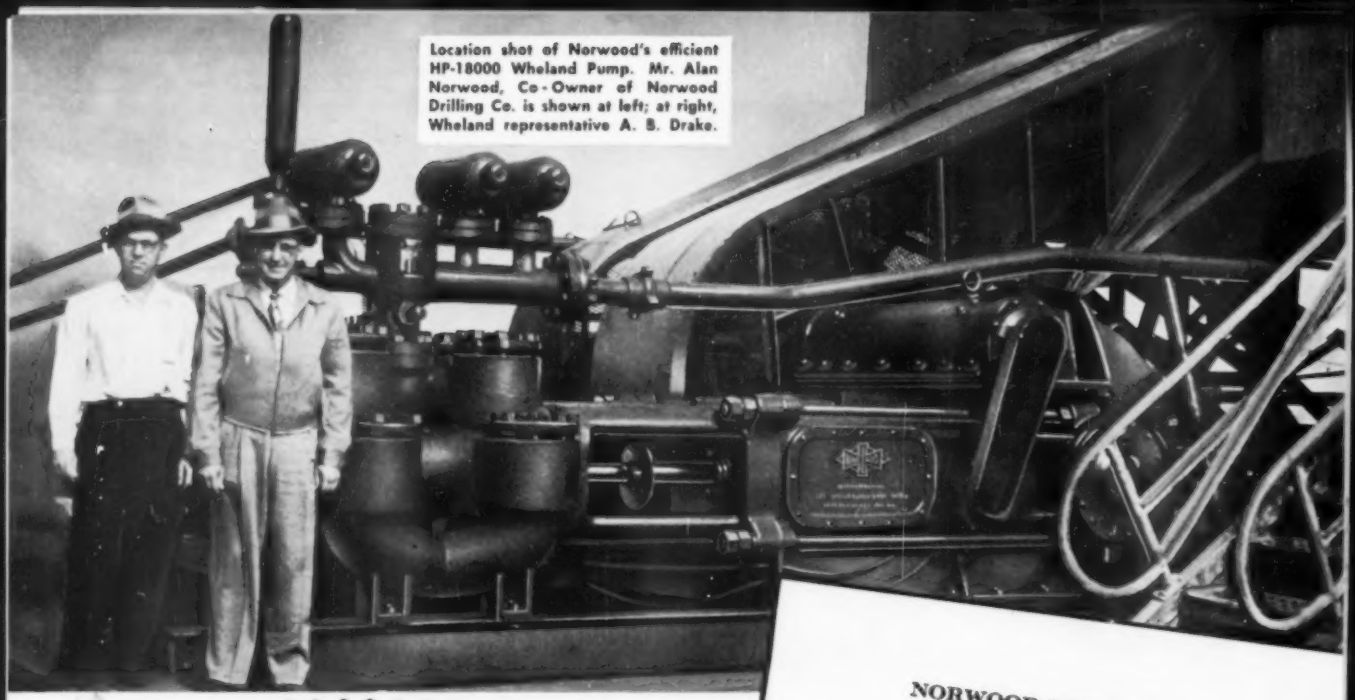
COMMERCE

OF HOUSTON

Facilities of the Oil and Gas Department of The National Bank of Commerce of Houston are available in Wyoming, Nebraska, Colorado, New Mexico, Louisiana, Mississippi, and Texas.

GULF BUILDING • MAIN AT RUSK • HOUSTON

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION



Location shot of Norwood's efficient HP-18000 Wheland Pump. Mr. Alan Norwood, Co-Owner of Norwood Drilling Co. is shown at left; at right, Wheland representative A. B. Drake.

PERFORMANCE!

"... has fully met our expectations on performance ..."

"have had no expense on this pump"

NORWOOD DRILLING CO.
WICHITA NATIONAL BUILDING
WICHITA FALLS, TEXAS

January 21, 1958

Mr. Gordon P. Street
The Wheland Company
Signal Mountain Road
Chattanooga, Tennessee

Dear Mr. Street:

We operate six rigs in West Texas and New Mexico area; depths range from 5,000 feet to 14,000 feet.

The Wheland HP-18000 pump we bought more than a year ago has been in the West Texas area working on wells between 10,500 feet and 13,500 feet. It has fully met our expectations on performance and so far we have had no expense on this pump.

Yours very truly,

NORWOOD DRILLING COMPANY

By: Alan Norwood
Alan Norwood

WHELAND HP-18000

DUPLEX SLUSH PUMP

7¾" x 18", 750 HP Nominal Input at 60 RPM.
Discharge Pressure with 7¾" liner, 1322 PSI;
Discharge Pressure with 5½" liner, 2700 PSI.

BULLETIN ON REQUEST

WHELAND

ROTARY DRILLING MACHINERY

THE WHELAND COMPANY
CHATTANOOGA, TENNESSEE, U.S.A.

DRAW WORKS • SLUSH PUMPS • ROTARIES
CROWN BLOCKS • TRAVELING BLOCKS • SWIVELS

DOMESTIC DISTRIBUTORS: INDUSTRIAL SUPPLY COMPANY, INC.—Main Office: Wichita Falls, Texas • HOUSTON OIL FIELD MATERIAL COMPANY, INC.—Main Office: Houston, Texas • JONES-AND LAUGHLIN STEEL CORPORATION, SUPPLY DIVISION—Main Office: Drawer 2481, Tulsa 2, Oklahoma.

EXPORT DISTRIBUTORS: LUCEY EXPORT CORPORATION—233 Broadway, New York 7, New York—Broad Street House, London, E. C. 2, England.

New Reliance Oil Field Motors Designed for Oil Well Pumping Service

The New Reliance Oil Field Motors are high torque, medium slip motors. This tested and proved design is tailored to load conditions peculiar to oil well pumping service. The special Reliance design provides maximum motor life, and minimum current surge.

Motor Enclosure

The mechanical design of Reliance Oil Field Motors meets all outdoor conditions. Openings are screened and all electrical components are protected from the elements. Metermatic Bearing Lubrication, exclusive with Reliance, keeps bearings greased for extended periods of time without attention.

Deliveries

Reliance Oil Field Motors can be shipped immediately from Cleveland, Tulsa, Dallas and Houston. These are 220/440 volt, 1200 rpm. motors from 5 through 25 hp. Other motors are available from Cleveland. Stocks of Oil Field Motors will soon be available in California and the Rocky Mountain States.

Contact your Reliance Representative for prices and further details. B-1598

RELIANCE ELECTRIC AND ENGINEERING CO.

DEPT. 107A, CLEVELAND 17, OHIO
CANADIAN DIVISION: TORONTO, ONTARIO
Sales Offices and Distributors in Principal Cities

W-K-M's *Creative Engineering* has designed, produced, tested this production valve for you

The creative engineering process at W-K-M is intensely practical. It studies your problems—on the rig and at the Christmas Tree—and creates practical solutions for them.

The process begins with the design, extends through production, includes the most rigorous testing in the business: before it's shipped, every W-K-M production valve is tested against pressures higher than any it will control in your service.

That's why W-K-M production valves have earned such a fine reputation for performance throughout the world, why field men recommend them, and engineers specify their use.

When you install a W-K-M production valve, you give your operation the benefit of a valve designed, produced and tested for *your* use.

Ideal for Sand Fracturing Service

This drawing shows how the bore through the body and gate of a W-K-M production valve is isolated by the gate segments from the body of the valve • Diameter of the bore equals that of the pipe (this provides a full, smooth flow, the same as through the pipe) • This eliminates the turbulence that will cut out an ordinary valve under high pressure in a short time • Seats are fully protected from the possibility of being cut-out by sand-laden fluid, because the fluid never touches them in either the open or closed positions • The valve seals both upstream and downstream; any accumulation in the body can be flushed-out through drain plugs while the valve is under pressure.

ON HAND

The most used sizes of W-K-M Gate Valves are carried by supply stores everywhere. Special sizes and special designs are produced as you need them.

W-K-M

DIVISION OF ACF INDUSTRIES
INCORPORATED
P. O. BOX 2117, HOUSTON, TEXAS
Export Office: 45 ROCKEFELLER PLAZA, NEW YORK, N. Y.

3815

New drawworks for faster, more efficient drilling

700 to 1200 HORSEPOWER

MID-CONTINENT U-712-A

This all-new U-712-A drawworks, rated at 700-1200 net input horsepower, incorporates many outstanding features to increase drilling speed and efficiency. Manufactured by Unit Rig & Equipment Co., a subsidiary of Mid-Continent Supply Co., the U-712-A includes these important advantages:

- **NEW** Unitized controls, conveniently located in a single console, result in greater operational efficiency.
- **NEW** Grease lubrication of bearings with flood lubrication provided for chains, sprockets and splined clutches.
- **NEW** Self-equalizing 48" diameter brakes designed for rapid, drag-free release and smooth feed-off operation.
- **NEW** Fawick VC clutches mounted on the drum shaft for low and high drives, with an emergency splined clutch provided for the low drives.

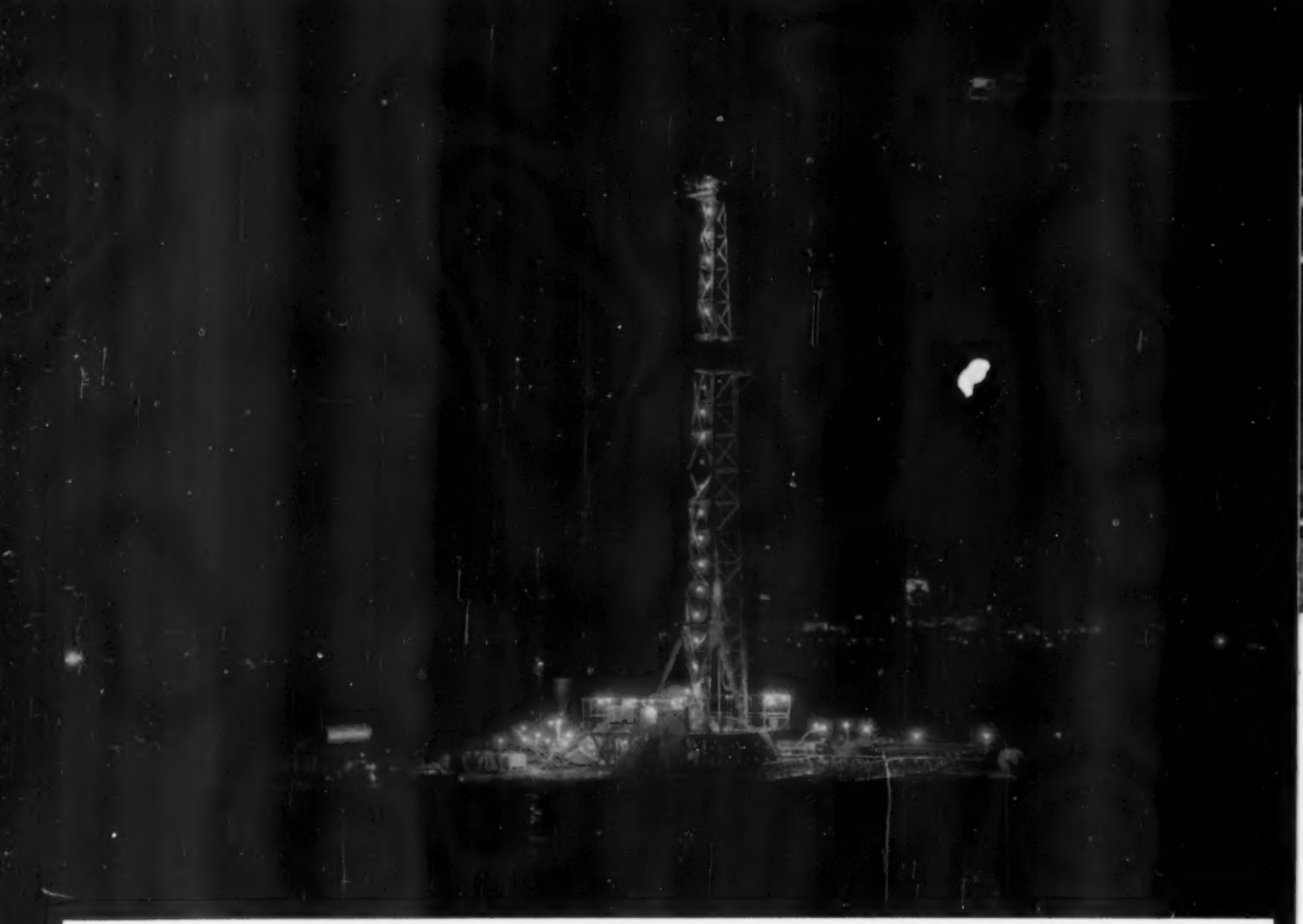
The U-712-A is designed as an integral drilling unit which includes hoisting drum, transmission, rotary drive and auxiliary brake. For complete information, write for our U-712-A Bulletin or contact your local Mid-Continent representative.

DW3-8

MID-CONTINENT SUPPLY CO.

MID-CONTINENT BUILDING • FORT WORTH, TEXAS
Export Division: 45 Rockefeller Plaza, New York 20, N. Y. Cable: MIDCUMPORT NYK

THE WORLD'S LARGEST INDEPENDENT OIL FIELD SUPPLY COMPANY



Around the clock at Glover #1, drilling by the Nuckolls-Bell Drilling Company in the Oklahoma City field continues toward pay sand 6500 feet below surface. String of 4½" Grade D Pittsburgh Seamless drill pipe helps to drive to completion quickly, efficiently. Even at night, drilling crew knows that nearby Pittsburgh independent distributor will help out in emergency to keep rig running.

Born of the Oil Boom

Good service is natural to this Pittsburgh Steel distributor with three generations of field experience

Good service from this Pittsburgh Steel independent distributor is a family habit that started back around the turn of the century when a young blacksmith pounded out crude drilling tools for a supply house during the oil boom in the Oil City area.

Drillers of that day were constantly experimenting—devising a wide variety of tools to meet ever-changing conditions. Quickly, this man, who later founded his own independent supply company, learned to cater to the whims of these drillers and to make the tools they wanted when they wanted them.

As the search for oil moved steadily West—out of Pennsylvania into West Virginia and Ohio—across Illinois and Kansas—on to Oklahoma and Texas—the blacksmith and his family, which included four sons, followed.

The father continued to produce the tools needed by the oil men.

Eventually, the father and sons started their own supply business—opened their first store in 1926.

Past experience, their close everyday association with the needs of the booming oil industry, plus a desire to serve their friends, brought them recognition as leading suppliers of oil field production equipment.

Being independent, they could choose to handle only the best—which is why they picked Pittsburgh Steel Company seamless drill pipe, casing and tubing as an important part of their line.

One of their district managers, Wayne G. Wallace, says, "That decision to supply Pittsburgh Seamless to our customers has paid off—has helped maintain our reputation for handling quality material. I've sold thousands of feet of Pittsburgh drill pipe, for instance, and never had a minute's trouble. Everybody seems to be exceptionally well pleased."

At the rig Wayne G. Wallace, distributor's district manager, talks over Pittsburgh drill pipe performance with driller Clifford A. Funk. Daily contact like this enables distributor's field force of more than thirty men, plus another seventy in stores and offices to anticipate and furnish needed items promptly. Stores are linked with teletype system to provide maximum flexibility and service.

Following through on drill pipe order, Wayne Wallace makes sure that correct number of drill pipe lengths have tool joints flash welded to pipe as specified. Service such as this has built strong customer loyalty to his firm—even in distant lands. To Jamaica in the British West Indies, this distributor shipped a 7500-foot string of Pittsburgh 3½" Grade D Seamless drill pipe and other production items on a rush order.

The policy of handling quality products at competitive prices—the flexibility of their service—the lack of red tape—their interest in community affairs are typical of the Pittsburgh Independent Distributors listed at the right. They are on the job day and night servicing the operators from a total of 140 stores.

In the case of this particular distributor, the soundness of the founder's independent policy enabled the company to multiply its original store nine-fold. Now sons and grandsons operate two stores in New Mexico, three in Oklahoma, three in Texas and one in Cortez, Colorado; plus offices in Fort Worth, Dallas and Midland, Texas; Denver, Colorado; Tulsa and Oklahoma City, Oklahoma.

Through these offices and stores, the family continues building its tradition of service to the oil industry —a tradition founded on years of experience plus a determination to supply the best materials on time.

It will pay you in service and quality goods to deal with the Pittsburgh Independent Distributors listed here. For your next string of drill pipe, casing or tubing get the pipe of your choice from the supplier of your choice. Specify Pittsburgh Seamless.

Distributor Home Offices

Bradford Supply Company
Bradford, Pennsylvania

Buckeye Supply Company
Zanesville, Ohio

Cardwell Manufacturing Co.
Wichita, Kansas

C. W. Cotton Supply Company
Tulsa 5, Oklahoma

Franklin Supply Company
Chicago 5, Illinois

Houston Oil Field Material Co.
Houston, Texas

Industrial Supply Company
Wichita Falls, Texas

Iverson Supply Company
Tulsa, Oklahoma

Longhorn Supply Co., Inc.
Houston 14, Texas

Lucey Export Corporation
New York 7, New York

Lucey Products Corporation
Tulsa 19, Oklahoma

McJunkin Corporation
Charleston 22, West Virginia

Midland Supply Company
Wichita 7, Kansas

Mountain Iron & Supply Co.
Wichita 2, Kansas

Murray Brooks, Incorporated
Lake Charles, Louisiana

The Producers Supply & Tool Co.
Fort Worth 2, Texas

Production & Refining Equipment Company
Odessa, Texas

Sandy Supply Company
Wooster, Ohio

Southwest Supply Company
Pittsburgh, Pennsylvania

Superior Iron Works & Supply Co.
Shreveport, Louisiana

Western Supply Company
Tulsa 1, Oklahoma

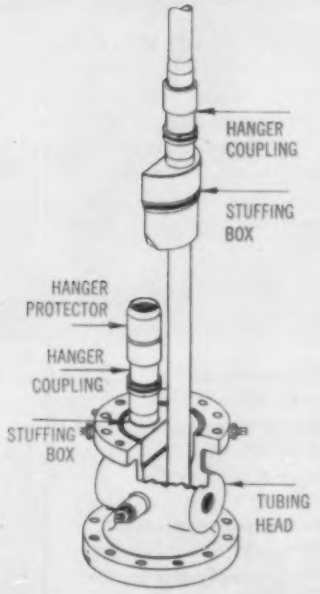
Pittsburgh Steel Company

Grant Building • Pittsburgh 30, Pa.

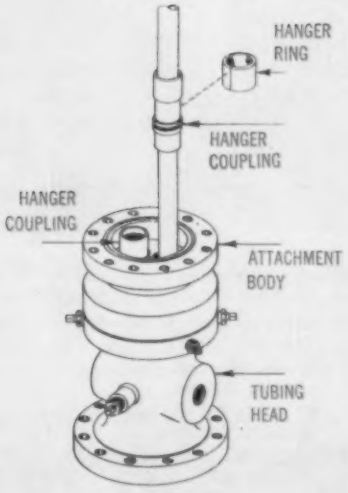
District Sales Offices

Atlanta	Cleveland	Dayton	Los Angeles	Pittsburgh
Chicago	Dallas	Detroit	New York	Tulsa
		Houston	Philadelphia	Warren, Ohio

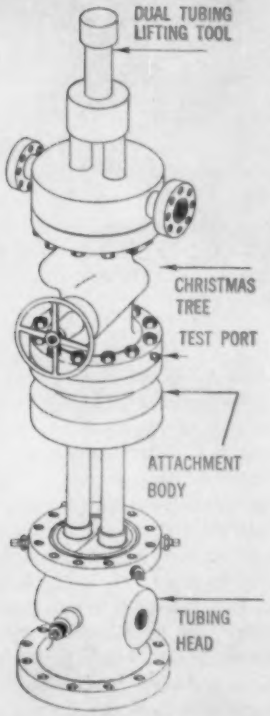
NOW--SAFE, COMPLETE CONTROL AT ALL TIMES



1. Stuffing boxes and tubing hangers are landed in the O-C-T Universal Tubing Head. Well is protected by Otis Back Pressure Valves. Stuffing boxes are used in place of dual hangers in the O-C-T Universal Tubing Head.



2. Hanger is lowered into the attachment and landing joint removed. Both strings are now hung.



3. After mud is circulated out of tubing and both zones are in, tubing is lowered and attachment body is flanged up and tested. If workover is necessary, well may be killed by lifting tubing and circulating mud.

THE NEW O-C-T "U-65" TUBING HANGER ALLOWS BOTH STRINGS OF TUBING TO BE RAISED SIMULTANEOUSLY AT COMPLETION

The new O-C-T U-65 Dual Tubing Hanger Assembly makes it possible to bring in or to kill both zones of a dual completion simultaneously under full pressure control and without down-hole circulating valves. The U-65 works efficiently with all types of packers, any combination of packers, and including hydraulic packers.
Ask your O-C-T representative for full information.
This is another in an entire group of revolutionary new developments by O-C-T. Watch for more!

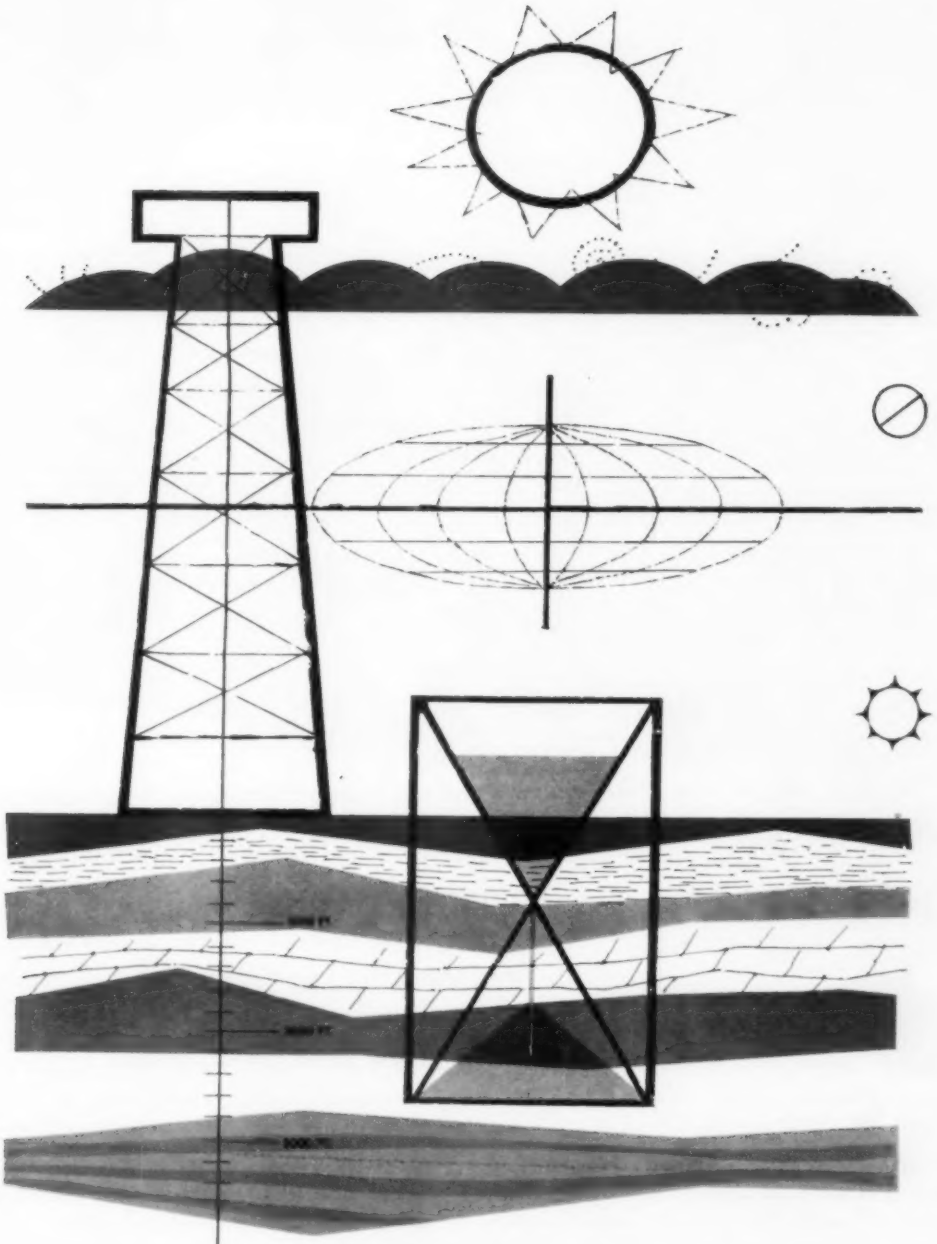
where progress is a daily practice

O·C·T

OIL CENTER TOOL CO.

SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION

Address Export Inquiries for All Countries to
P. O. Box 3091, Houston, Texas.



NBT

THE BANK THAT WAS BORN IN THE OIL FIELD

OIL BANK OF AMERICA

Oil men like to deal with banking men who know Oil as well as they know Banking. In the Oil Department at National Bank of Tulsa, there's no separating of Oil from Banking—they're one and the same — because NBT was "born in the oil field" and continues to key its own progress to the healthy growth of the oil industry.

NATIONAL BANK OF TULSA TULSA, OKLAHOMA

Member Federal Deposit Insurance Corporation

Mr. C. J. Bender, President of Trinity Steel Co., and his latest 10,300-gallon propane transport built lighter and stronger with USS "T-1" Steel.

1,200 gallons ride free in this propane transport built from USS "T-1" Steel

This 10,300-gallon propane transport was built by Trinity Steel Company of Dallas, Texas. Mr. C. J. Bender, President, says: "The 12½% increase in payload capacity was made possible by the use of lightweight construction with USS "T-1" Constructional Alloy Steel. This can amount to as much as 1,200 extra gallons per trip which are carried free, since the gross weight remains the same. Our customers figure that the increased profits earned in the first season more than offset the small price differential involved."

The success of these large blimp transports has generated so much interest that many local LPG dealers are ordering "bobtail" or truck-mounted home delivery units with tanks made of USS "T-1" Steel. On these smaller tanks, payload capacity is increased as much as 50%. A new 3,000-gallon truck weighs no more than the old 2,000-gallon unit, while operating costs stay the same.

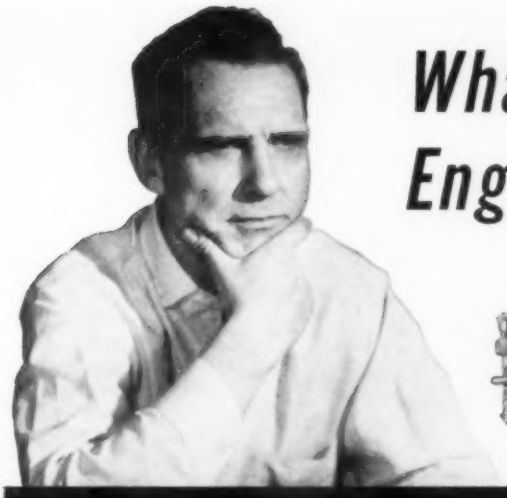
For code-governed applications, USS "T-1" Steel is furnished to 90,000 psi minimum yield strength. It is also available for non-code applications with a minimum yield strength of 100,000 psi. Its high yield strength coupled with exceptional toughness, weldability and resistance to atmospheric corrosion make it ideal for pressure vessels, tanks, derricks and equipment where great strength without bulk is required. *For complete information, write to United States Steel, Room 2801, 525 William Penn Place, Pittsburgh 30, Pennsylvania.*

USS and "T-1" are registered trademarks

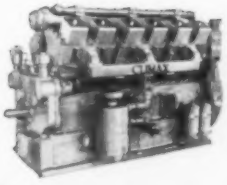
USS

United States Steel Corporation—Pittsburgh
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Supply—Steel Service Centers
United States Steel Export Company

United States Steel

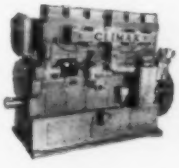


What Is A Profitable Engine Investment?

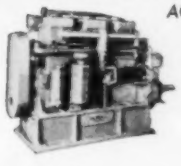


IS IT THE RIGHT ENGINE FOR THE JOB?

HOW EASY IS IT TO MAINTAIN?



WHAT ABOUT SERVICE?



ARE SPARE PARTS AND ACCESSORIES READILY AVAILABLE?

A LITTLE THOUGHT ON THIS SUBJECT CAN SAVE A LOT OF MONEY!

Your engine is an investment in work that needs to be done, now and over a long period of time. The efficiency of its work and the length of time depend substantially on effective maintenance and service. This adds up to simple arithmetic: the best engine for your purpose + the ease with which it can be maintained + fast and reliable service and parts facilities = *a profitable engine investment.*

This is the Climax formula. It's the reason why Climax owners are such satisfied owners.

First, they can select the engine *just right* for their need from a complete range of 6's to V-12's, 40 to 605 max. hp. (1200 rpm.). Second, they get an engine that features easy access to all functional parts to simplify field maintenance. Third, they get the best available parts and service facilities through the nationwide network of Waukesha-Climax Distributors.

Ask *your* Waukesha-Climax Distributor for the complete facts.

CLIMAX

a complete line of gasoline, gas or butane engines for drilling rig, compressor and pump service . . . 6 cylinder to V-12 . . . basic engine ratings from 40 to 605 max. hp.

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WAUKESHA SALES AND SERVICE, INC.
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KANSAS ENGINE & MACHINERY CO., INC.
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DIVISION OF WAUKESHA MOTOR COMPANY
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Get longer tool-joint life— use Humble's **THREDKOTE 701**

THREDKOTE 701 is a top-quality thread lubricant containing 60% pure metallic zinc. When the joint is made up tight, the zinc in THREDKOTE 701 is deposited on the threads in a thin film. As the string is run, this zinc film effectively guards against metal-to-metal contact and prevents galling. The result: *longer tool-joint life.*

THREDKOTE 701 gives tool-joint threads superior lubrication. Joints make up tight and break out easy. And THREDKOTE 701 maintains its quality and consistency under the most rugged running conditions.

It is essential to give new tool-joint threads a careful and complete coat of THREDKOTE 701 for their first four or five trips. New tool joints resist make-up more than used tool joints; need extra lubrication and protection. The continued use of THREDKOTE 701 on each trip will keep your string running tight and true.

● *THREDKOTE 701 is one of a complete line of Humble thread compounds. There's one for almost every type of threaded connection. For more information on THREDKOTE, call your nearest Humble wholesale plant, or phone or write:*

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Sales Technical Service
P. O. Box 2180
Houston 1, Texas

HUMBLE

HUMBLE OIL & REFINING COMPANY

Cementing and fracturing hose of steel, comprising Chiksan Joints and Weco Unions, have long been standard equipment with service companies.

new NEW

Chiksan has developed a new kind of swivel joint for oil well cementing. This joint has a wide turning radius and a new process-hardened steel to minimize cavitation and washout, plus a new wedge-shaped packing that cannot be sucked into the stream. It's called the Longsweep and it has produced highly spectacular results.

In two years of field testing, this new joint has proved itself better than any previous cementing joint ever used. Cementers report a minimum of 3-to-1 service life over old joints. This newest development is another Chiksan effort to reduce drilling costs.

CHIKSAN Longsweep SWIVEL JOINT

triples cementing hose service life . . .

CHIKSAN fmc

A SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION

58-35

CHIKSAN COMPANY—Brea, Calif. • Chicago 5, Ill. • Newark 2, N. J. • Weco (Division), Houston 1, Texas • Subsidiaries: Chiksan Export Co. • Chiksan of Canada, Ltd.

Tuffy® Wire Rope

"Preventative Maintenance" Will Give You Longer Wire Rope Service

Every motorist knows the importance of proper lubrication for cars. It's essential for wire rope, too. For wire rope is a "machine" of precision moving parts. And friction is enemy No. 1 of all machinery.

Lubrication during fabrication

There are two distinct phases of lubrication: in manufacture, and in use. Wire rope engineers consider the lubricant as part of the rope; the kind, consistency and amount of lubricants are controlled and applied as required. Applications are usually made hot for the inside and external surfaces.

Lubrication in the field

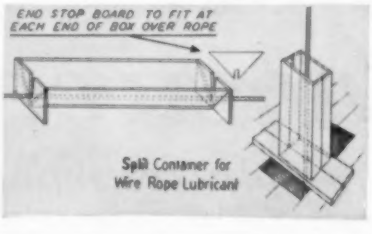
Here only an external application of lubricants is possible. It must penetrate to the inside of the rope to get a film of oil between the strands and the core. The lubricant can be applied either hot or cold, depending on its penetrating quality.

To find the best lubricant for your wire rope, talk to a local oil company engineer. He'll recommend the oil and method of application best suited to your needs.

How much and how often?

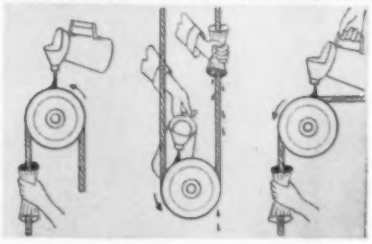
There's no set rule. It depends on service conditions. The heavier the duty, or the greater the number of bends, or the more corrosive the fluids in which the rope operates, the more frequent should be the lubrication. Remember one thing. The core is not an oil reservoir for external lubrication of the rope. No such action takes place. The oils "built" into the fiber core during its fabrication are to preserve and lubricate the vegetable fibers, not the external steel wires.

Two Types of "home-made" oiling devices



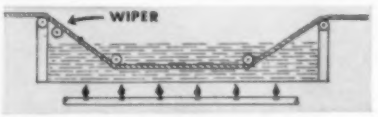
They're simple and do a good job. One is for vertical ropes, the other for horizontal. A heavy crankcase oil, cylinder oil or similar lubricant, preferably heated, is placed in the lubricators when the rope is run through.

Other Methods of lubrication



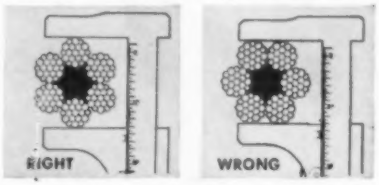
The pour-on method for manual lubrication is effective when penetrating, yet adhesive, oil is used. Oil should be hot. Hold the wiping swab BEHIND the sheave. This catches any excess oil that would be carried on along the rope.

Metal split box for bath treatment has a burlap collar or wiper at outlet end.



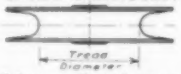
Hot bath method of applying heavier-bodied lubricant at high temperature. Gas burners or steam heat may be used. Pre-heated lubrication is always more penetrating. Rope should run through slowly to insure penetration.

How to measure rope diameter:



Use a machinist's caliper. Be sure to measure the widest diameter.

How to measure tread diameter:



Select smallest sheave or drum to be used with new rope, and measure actual diameter of tread.

Sheaves with grooves corrugated with rope lay impression should be replaced with new ones before installing new wire rope.

New ropes are usually over-size. It is advisable to have groove diameters of sheaves or drums as large as the actual calipered diameter of the new rope, or slightly larger. We recommend sizes as follows:

58-4

Tips

Too much strength can be a weakness... Wire rope must be BALANCED

Recommended sizes:

Diameter of Rope	Minimum Dia.	Maximum Dia.
1/4-5/16	+ 1/64"	+ 1/32"
3/8 - 3/4	+ 1/32"	+ 1/16"
7/8 - 1 1/8	+ 3/64"	+ 3/32"
1 1/4 - 1 1/2	+ 1/16"	+ 1/8"
1 5/8 - 2 1/4	+ 3/32"	+ 3/16"
2 3/8 and larger	+ 1/8"	+ 1/4"

How to check groove diameter:

Sometimes extra strength is heavily stressed in selling wire rope. While strength is important in every operation where wire rope is used, it is not the only important quality, and there are cases where excessive strength is a liability.

For example, the manufacturers of scrapers have designed the components of their equipment to take certain loads. These loads are controlled by or subject to the ultimate strength of the rope. Larger ropes with their accompanying higher strength do not break but *the equipment itself begins to* break up. Another feature of scraper rope is resistance to crushing. Strength is not the factor which controls the best design to resist crushing.

Union Wire Rope gives you the PROPER BALANCE of strength, toughness, flexibility and other properties most desirable for rope efficiency and long life. Don't settle for less. Your Union Wire Rope distributor has the BALANCED rope for every use.

Special Purpose Ropes: tailored & BALANCED for special uses

Tuffy BALANCED Rotary Lines

JACKKNIFE Rotary Line. Combines proper balance of extra strength and extra flexibility. Spools easily on small sheaves and drums of jackknife rigs drilling to 6000 ft.

STANDARD Rotary Line. For top performance in drilling use with standard rigs in any formation. Also a star performer in deep drilling beyond 6000 ft. with jackknife rigs.

Tuffy BALANCED Slings and Hoist Lines

This team has made a name for cutting hoisting and downtime costs in all types of materials handling: Tuffy Hoist Line, the longer running rope, and Tuffy Slings, made of an extra flexible machine-braided fabric that smooths out uninjured after knotting or kinking.

Easy to order! Just say **Tuffy** *... give length and size! No complex specifications.*

union Wire Rope corp.

SUBSIDIARY ARMCO STEEL CORPORATION

2102 Manchester Ave. **Kansas City 26, Mo.**

Specialists in high carbon wire, wire rope, braided wire fabric, stress relieved wire and strand.

Ordering is ABC-Simple!

No complicated codes or long list of specifications. Just say "Tuffy," give type (Scraper Rope, Dozer Rope, etc.), length wanted and size. Just that easy!

Good Man to Know — Your Nearby Union Wire Rope Distributor

Whether your wire rope need is a scheduled replacement or a red-hot emergency, your Union Wire Rope distributor is ready with "right-now" service. He keeps varied stocks of Union standard constructions and the Tuffy Special Purpose Ropes. And he's backed by quick service from his nearby Union Wire Rope depot.

If it isn't rope you need, but advice on a wire rope problem, he's just as ready to help. If you don't know your Union Wire Rope distributor already, look under "Wire Ropes" or "Slings" in your telephone directory yellow pages.

The **NEW**

Sherman PANTHER POWER DIGGER

with Quick Detach and Many Exclusive Features

The introduction of the new Sherman Panther Power Digger obsoletes all other tractor mounted backhoes. Before you buy any power digger, compare it feature for feature with these Sherman advantages: • For all Ford Gas and Diesel Tractors • Rear mounted hydraulic system to eliminate long, power-robbing lines • Special transmission to step up power take-off shaft speed to permit use of small pump delivering 2000 P.S.I. • 25 horsepower hydraulic system • 2-way chevron packings with phenolic top and bottom rings to act as bearings and prevent metal to metal contact between cylinder walls and pistons • Flow control valve to eliminate all chain slack and assure positive control in every digging position • Stress-design box construction boom • Quick detach in a matter of minutes • Reinforced stress-design box dipstick • 19,250 lbs. digging force available • Shock absorbing subframe • Individually controlled stabilizers • 188° uninterrupted arc of swing • and many other features. Write today for Bulletin No. 1586.

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POWER DIGGERS
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SHERMAN PRODUCTS, INC., Royal Oak, Michigan

SOIL WORKING TOOLS
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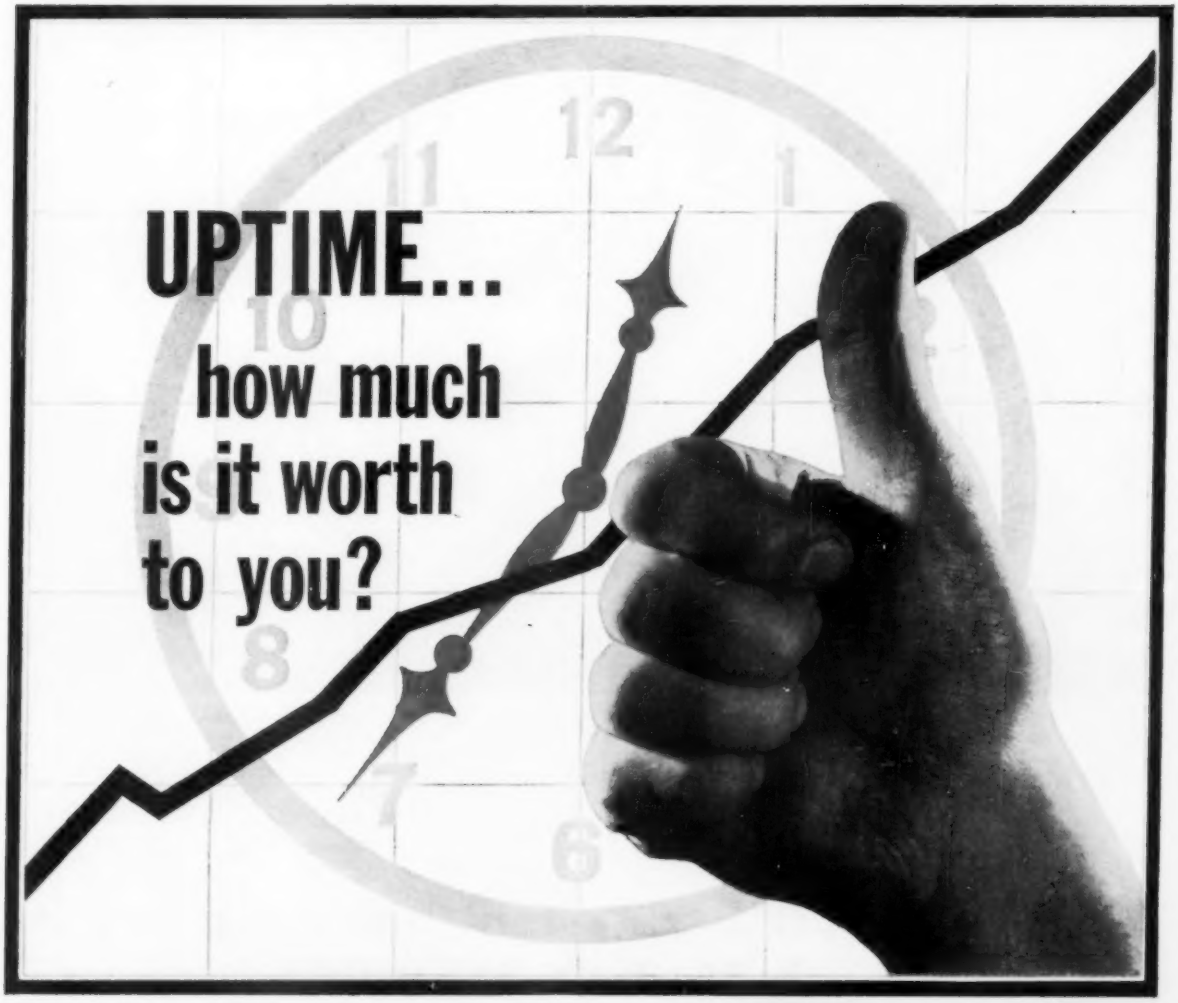
US RUBBER PACKING

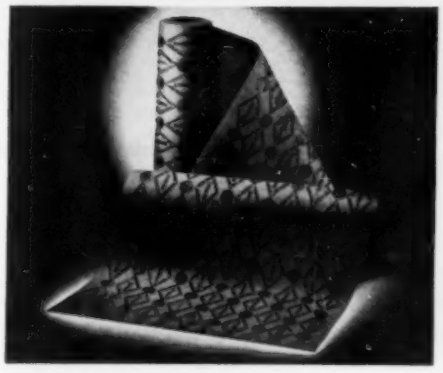


These days, everyone talks about *downtime costs*. Few consider how much *uptime is worth*—the great majority of time when production runs smoothly. How much is uptime worth to *you*, each hour? $100–$200–$300?

And how much are you willing to spend each hour for a packing that will help keep your pumps and flow lines maintenance free? 1¢ – 2¢ – 5¢?

That's the kind of money involved when you use a packing like U. S. Rainbow®—first in red sheet packing. Each extra hour of production uptime means hundreds of dollars in production, yet those same extra hours of packing uptime can be had for just pennies... the difference in cost between a quality packing like U. S. Rainbow and ordinary packings.

Rainbow is designed to pack flanges or other parallel surfaces against hot or cold water, air, saturated steam (up to 150 lbs.) and many other hydraulic conditions—and to pack them for longer hours of *uptime*.



When you think of rubber, think of your "U. S." Distributor. He's your best on-the-spot source of technical aid, quick delivery and the finest quality industrial rubber products.

US RUBBER

Mechanical Goods Division

United States Rubber

WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

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Despite the Tripod Derrick's size, complete moves are easy for Strait Drilling, Inc., of El Dorado, Kansas . . . a matter of three days overall for an average 30-mile move. Here, their 36-L is working at the 390-ft. depth on a well near Lost Springs.

Top-to-bottom drilling of a well near Adin, Alberta, Can., is handled by this 48-L equipped with Tripod Derrick. The hole was started at 15½-in. dia. and 10-in. dia. casing was used at the 480-ft. depth.

Like these spudder owners . . .

You can boost heavy-tool handling profits with TRIPOD DERRICKS

A Bucyrus-Erie 36-L or 48-L spudder equipped with a field-proved, heavy-duty Tripod Derrick can solve your heavy-tool work problems. This sturdily-built 70-ft. derrick provides sufficient height to handle casing loads up to 300,000 pounds when rigged for 10-part hoist.

With a Tripod Derrick, you not only get big capacity, but top portability. Erection of the five-unit derrick is easy. Tear downs and moves are quick and simple. Each unit — upper and main front lower sections, two rear lower triangular legs, and steel substructure — can be disassembled and transported separately.

Check the illustrations and captions. Then take the first step toward enjoying this portable tower of strength on your heavy-tool work: visit your nearby Bucyrus-Erie spudder distributor for the full story. Ask for complete details on derricks available for 36-L and 48-L spudders. 56558

BUCYRUS ERIE BUCYRUS-ERIE COMPANY • DRILL DIVISION • U. S. HIGHWAY 40 WEST, BOX 324, RICHMOND, INDIANA

FIRST* with the *FINEST* in *SPUDDERS

Sound that the eye can see

This is the Schlumberger Sonic Log—a visual record of sound velocities. Here is a whole new system of logging—the measurement of a formation property completely distinct from its electrical or radioactive characteristics.

The Sonic Log is rapidly taking its place in the search for oil with other Schlumberger logging methods. See how it may help you on your next well.

The Sonic Log provides: • Accurate porosity values in medium to hard formations. • Excellent correlation from exacting detail due to its closely spaced detectors. • Clear indications of geological changes not apparent on other logs. • Differentiation between water, oil and gas in high porosity formations. • Data for better interpretation of seismic diagrams.

For better interpretation of seismic surveys, look into the Schlumberger Seismic Reference Service. By contractual arrangement with the widely experienced Century Geophysical Corporation, the Sonic Log is augmented with surface tie-in and well geophone shots to provide a complete package velocity service.

THE EYES OF THE OIL INDUSTRY®

SCHLUMBERGER

in TULSA, ODESSA and HOUSTON
only TEX-TUBE
has really complete stocks
of MACARONI TUBING
3/4", 1", 1-1/4", 1-1/2", 2-1/16" OD
upset • non-upset • special clearance
and beveled couplings • integral joints

skyline of Tulsa

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1503 NORTH POST OAK ROAD • HOUSTON, TEXAS

Sales Offices in Midland, Texas - Tulsa, Oklahoma
Baton Rouge, Louisiana

They Say—

1908 experiment a failure

Dear Sir:

I have noted with some interest the September 6, 1908, reprint about a 282-mile water-lubricated pipeline in "The JOURNAL Said" column of the September 1 issue.

Where could I find further information on the success or failure of this undertaking?

Charles S. Brown
Gulf Research & Development Co.
Pittsburgh

(Editor's note: Associated Pipe Line Co. at the time described the experiment with "rifled" pipe as a success. The company said the thin film of water held against the pipe by centrifugal force reduced friction between the heavy oil and pipe wall, permitting greater throughput of 14°-gravity oil than was possible by heating. However, it was understood later that the operation had to be dropped because the water-oil emulsion created could not be broken satisfactorily.)

Oil hits the school room

Dear Sir:

Thank you for making such a fine report on my article about "oil lessons" for school children (OGJ, Sept. 22, p. 45). Your compliments, too, are well received.

Your friendly response has renewed my faith in editors!

Ruth K. Stroh
Cockeysville, Md.

A broader geology needed

Dear Sir:

There can be a great future to geology provided it is expanded into a larger sphere of operations: Earth science.

Geology in the past has been too parochial a science, too limited in its scope. Moreover, it leaned too heavily on petroleum and mining industries.

Schools of earth science must replace the narrow training in geology, per se; geophysics, per se; geological engineering, per se; mining geology, per se.

In other words, the big picture is the wave of the future. This is a space age, the age of atomic and hydrogen nuclear research, the age of missiles, the age of the jet plane.

Only a basic attack on earth science can provide expanded opportunities for training and research in universities and colleges, for job opportunities later. This requires flexibility of mind and training. This is a race with the USSR, too, a race for survival in the atomic age.

Maury M. Travis
Denver.

Oil's greatest role

Dear Sir:

For the last several years I have watched the Oil Information Committee struggle to get its message across and have felt that one of their troubles has been that their arguments were based solely on the economics of the oil industry itself.

To really understand such lines of reasoning requires considerably more knowledge of the oil industry than the average person will ever possess. Therefore, these carefully thought out presentations have been somewhat disappointing. I believe that there are other approaches to this problem that can be explained in terms that the average man can understand.

My theme is simply this, the oil industry is the world's greatest colonizer and developer of virgin areas. People do not voluntarily disperse themselves when it means moving into areas having less favorable environments and where their standard of living could be lower.

With our exploding population gain, this tendency of peoples not to disperse will lead to serious consequences unless something has gone before to clear the forest, drain the swamps, build the roads, establish basic utilities, and prove to mankind that satisfactory living can be maintained in this previously unexplored land.

East Texas is a perfect example when one looks at this area before and after 1930. Venezuela and the history of Creole Petroleum are a wonderful example. They entered one of the world's rawest jungles, peopled by savages, and now are staffed from the executive department on down almost exclusively with trained natives who are the offspring of the former savages.

Similar conclusions can be drawn about the Arab world, the Four Corners area, Alberta, and Alaska (yet to come). This, to me, is the real hidden benefit of the oil business.

It is interesting to note that the countries having the biggest problems in basic development and dispersion of population masses, namely China, India, Central Africa, and Australia, are countries that have had no oil development . . .

Paul E. Hall
Goliad Corp.
Houston.

Honor grad congratulated

Dear Sir:

May I use this column to offer congratulations to Richard Barry (OGJ, "They Say," Aug. 11, p. 52) for his first class honors degree from the Royal School of Mines and for his admission of the constant up-to-the-minute information gained through reading his OGJ.

May I also say that I am glad to have helped in his interest and eventual subscription to the magazine.

Good luck, Barry.

Ghazi S. Mudher
Iraq Petroleum Co.
Kirkuk, Iraq.

World demand study needed

Dear Sir:

In 1907 my father, a banker dealing in oil shares, asked me whether the rumor that oil shares were limited was correct.

In 1917, an authority on oil and gas reserves, I concluded that oil and gas can be found in abundance in almost every part of the world, consequently, I visited many oil fields.

In 1922, as an engineer of Socony, I became impressed with the idea of producing only so much oil as can be sold immediately.

In recent years oil producers ignored this policy, wasted considerable funds for drilling wells which are now capped and burning off.

It is now time for The Oil and Gas Journal to take the lead and review the world-over demand compared with the quantities produced in various fields, also showing production as well as shipping costs to places of consumption as a guidance to producers and investors.

We in Canada will appreciate such current advice and continue to subscribe to your Journal.

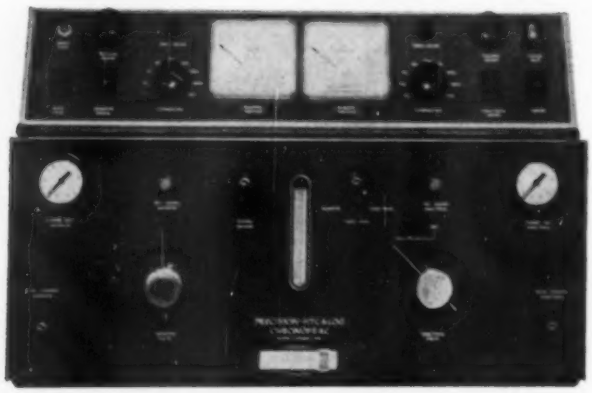
M.H.R. Durst
Petroleum Engineer
North Vancouver, B. C.

Letters to They Say should be addressed to The Editor, The Oil and Gas Journal, Box 1260, Tulsa, Okla.

HYCALOG

PRECISION-HYCALOG CHRONOFRAC Patent Pending IS NOW AVAILABLE TO ALL INDUSTRIES AND LABORATORIES

CONTINUING RESEARCH FOR LOWER COST EXPLORATION



This sensitive automatic gas analyzer, developed by HYCALOG's researchers, is now manufactured and sold by PRECISION SCIENTIFIC CO., Chicago.

Recommended for any processing operation involving gases, PRECISION-HYCALOG CHRONOFRAC provides continuously repetitive monitoring along with rapid qualitative and quantitative analysis. It is especially valuable in petroleum and chemical plants, research and school laboratories, paint factories, distilleries and food processing plants.

Sales for oilfield and well logging application are handled by HYCALOG; all others by PRECISION SCIENTIFIC.

Write for complete technical information and details on leasing or purchasing.

Hycalog, Inc.

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SHREVEPORT, LOUISIANA

BRANCH OFFICES IN PRINCIPAL OIL PRODUCING AREAS

DIAMOND CORING • DIAMOND BITS • WELL LOGGING • CORE ANALYSIS

CALENDAR OF EVENTS

OCTOBER

5-8 Society of Petroleum Engineers of AIME, fall meeting, Houston.
5-8 National Association of Corrosion Engineers, northeast region, Somerset Hotel, Boston.
5-9 American Society for Testing Materials, D-2 committee on petroleum products and lubricants, Mayflower Hotel, Washington.
7-8 Texas Mid-Continent Oil and Gas Association, annual meeting, Statler-Hilton Hotel, Dallas.
9-10 California Natural Gasoline Association, thirty-third annual fall meeting, Huntington - Sheraton Hotel, Pasadena, Calif.
10-12 Tri-State Oil Show, Roberts Municipal Stadium, Evansville, Ind.
12-18 OIL PROGRESS WEEK.
13-15 American Gas Association, annual convention, Atlantic City, N. J.
13-15 American Society of Mechanical Engineers, American Society of Lubricating Engineers, conference on lubrication, Statler Hotel, Los Angeles.
13-16 Society of Exploration Geophysicists, annual meeting, Hotel Gunter, San Antonio, Tex.
13-17 American Society of Civil Engineers, annual convention, Hotel Statler, New York.
15-16 South Dakota Independent Oil Men's Association, convention, Sheraton-Johnson Hotel, Rapid City.
15-16 University of Kansas, Southwest Kansas Center, sixth annual Gas Measurements Institute, Liberal, Kans.
15-17 National Association of Corrosion Engineers, north central region, Cincinnati.
15-17 Petroleum Conference on Well-Logging Interpretations, third annual conference, McMurry College, Abilene, Tex.
16-17 Society of Petroleum Engineers of AIME, Southern California petroleum section, Biltmore Hotel, Los Angeles.
16-18 New Mexico Geological Society, Arizona Geological Society, ninth annual field conference, Black Mesa basin, registration Gallup, N. M., Oct. 15.
16-19 Permian Basin Oil Show, Odessa.
19-21 National Association of Oil Equipment Jobbers, annual convention and trade show, Hotel Adolphus, Dallas.
20-21 Instrument Society of America, national rubber and plastics instrumentation symposium, Akron, Ohio.
20-24 National Association of Corrosion Engineers, south central region, Roosevelt Hotel, New Orleans.
20-24 National Safety Council, forty-sixth National Safety Congress, Conrad Hilton Hotel, Chicago.
22-23 National Association of Corrosion Engineers, western region, corrosion control course, U. S. Grant Hotel, San Diego, Calif.
22-25 Southwestern Federation of Geological Societies, regional meeting, Mineral Wells, Tex.
22-24 Society of Automotive Engineers, national diesel engine meeting, Lord Baltimore Hotel, Baltimore.
23-24 Rocky Mountain Oil and Gas Association, annual fall meeting, Town House Motel, Omaha.

23-24 Western Petroleum Refiners Association, refining technology and industrial relations meeting, Rufus Garrett Hotel, El Dorado, Ark.

27-28 Independent Petroleum Association of America, annual meeting, Statler-Hilton Hotel, Dallas.

26-28 Gulf Coast Association of Geological Societies, Driscoll Hotel, Corpus Christi, Tex.

26-31 American Institute of Electrical Engineers, general meeting, Pittsburgh.

31 Natural Gasoline Association of America, Southern regional meeting, Carlton Hotel, Tyler, Tex.

NOVEMBER

5-6 Society of Automotive Engineers, national fuels and lubricants meeting, Mayo Hotel, Tulsa.

6-7 American Association of Petroleum Geologists, Pacific section annual meeting, Los Angeles.

6-7 Louisiana Polytechnic Institute, School of Engineering, seventh annual instrumentation conference, Ruston, La.

6-8 Geological Society of America, national convention, St. Louis.

10 Transportation Club of the Petroleum Industry, annual meeting, Bismarck Hotel, Chicago.

10-13 American Petroleum Institute, thirty-eighth annual meeting, Conrad Hilton, Palmer House, and Congress hotels, Chicago.

18-20 Ninth National Conference on Standards, Hotel Roosevelt, New York.

18-20 National Conference on Air Pollution, Sheraton-Park Hotel, Washington, D. C.

19-21 Society of Petroleum Engineers of AIME, Venezuela petroleum sections, Caracas, Venezuela.

20-21 American Society of Civil Engineers, structural division and Kansas City section, conference on electronic computation, Kansas City.

21 Natural Gasoline Association of America, Panhandle Plains regional meeting, Herring Hotel, Amarillo, Tex.

30-Dec. 5 American Society of Mechanical Engineers, annual meeting, Statler and Sheraton-McAlpin hotels, New York.

DECEMBER

1-3 Interstate Oil Compact Commission, annual meeting, Kansas City.

2-4 Asphalt Institute, annual membership meeting, Shoreham Hotel, Washington.

7-10 American Institute of Chemical Engineers, annual meeting, Netherland Plaza Hotel, Cincinnati.

9-13 National Association of Corrosion Engineers, University of Illinois, biennial short course on cathodic protection.

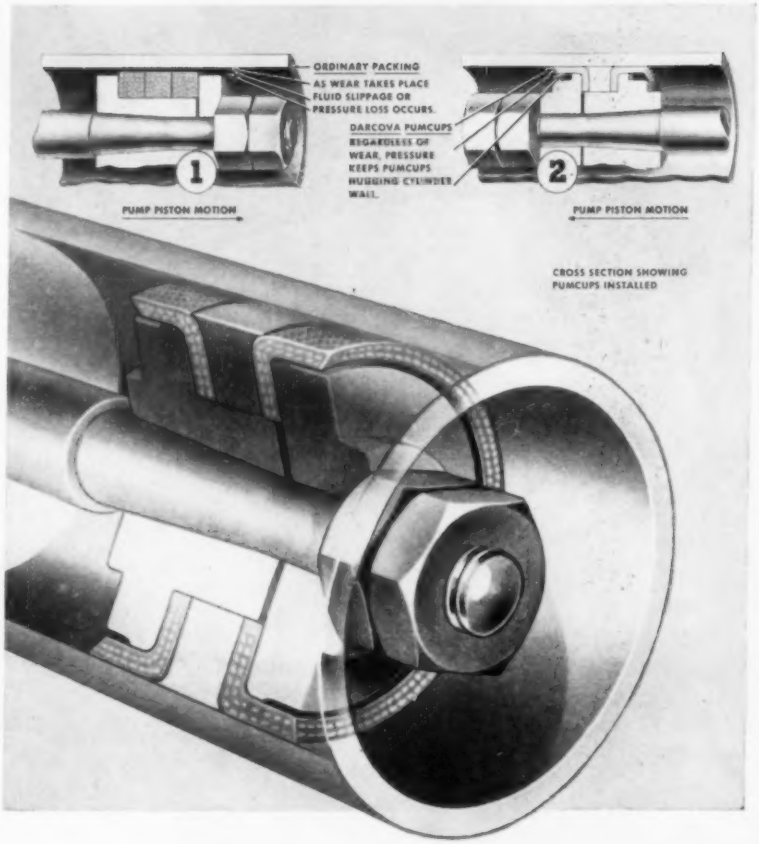
11-12 Mid-Continent Oil and Gas Association, annual advalorem tax forum, Hilton Hotel, Fort Worth.

JANUARY

22-24 Texas Society of Professional Engineers, annual convention, Shamrock Hilton Hotel, Houston.

23 Natural Gasoline Association of America, Oklahoma regional meeting, Biltmore Hotel, Oklahoma City.

28-29 Annual Midwest Welding conference, sponsored by Armour Research Foundation of Illinois Institute of Technology, and American Welding Society, Chicago section, Illinois Institute of Technology, Chicago.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JOURNALLY SPEAKING

Oil in Oil—and Water

IT'S LONG been argued that the oil business is more of an art than a science, but it remained for a couple of newspapermen to emphasize the possibilities of the industry for fine art—that is, as a subject for artists to render in oil or water colors.

These fellows—who insist they don't want any publicity—are the oil editor and the art editor of a Dallas newspaper. They got the idea that oil scenes are worth painting and that a collection of such paintings would make an interesting exhibit.

What's more important, they did something about it. They wangled some money for postage and printing from public-spirited but equally annonymous local citizens, circularized Texas artists, begged exhibit space, lined up judges, and—of course—enlisted the indispensable volunteer aid of the Desk and Derrick girls. Then they fast-talked a dozen oil and equipment outfits into putting up prize money of $100 to $400 each.

As a result they have a show. Around 100 entries were received, and more than 50 of the best are on exhibition in down-town Dallas throughout this month. The exhibit was conceived as a feature of Oil Progress Week, but now the sponsors are talking about making it permanent or perhaps putting it on the road and showing it all over Texas.

Whether you like realism, impressionism, expressionism, abstractionism, or any other form of art "ism," you'll find examples in this exhibit. It just goes to show that you never can tell how an oil scene looks through the eyes of an artist.

It also goes to show that you never can tell what aspects of the oil industry people are interested in until you get out among them and do some sociological wildcatting.

There have been oil-art shows before, but usually sponsored by a single big company. This Dallas deal is mighty good community relations, and also an assist in the industry's public relations. Of course it doesn't do anything to explain the depletion tax or the price of gas, but it does show the public that there is more to the industry than a cash register. And if any oil men should take the trouble to visit this exhibit themselves they would learn that the physical manifestations of their business have unsuspected aspects of beauty. They might also pick up a little culture to boot.

Complaint Box

WE READ a lot about the troubles of Libya, that ancient Arab land trying to become a modern independent nation amid the pressures of Egypt to the east and the French to the west, and where patterns of thought are being upset by the influx of American oil operators.

Now, according to a clipping from a Tripoli newspaper, the King has decreed that "Citizens Complaint Boxes" are to be stationed in prominent places all over the country. People are assured that grievances deposited there will be sealed and sent directly to the king and he will read them personally.

That's a new switch in democracy and freedom of speech. In the United States people with grievances write letters to the editor.

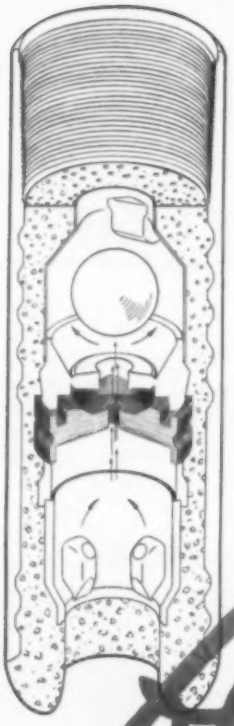
For us, it's probably a better system. Of course the President doesn't read them, but he probably wouldn't read your letter if you wrote directly to the White House. And here government policy is set by public opinion rather than by a king, and what better way is there of influencing opinion than by airing grievances in the press?

Which reminds us to remind you that The Big Yellow Book has a letters-to-the-editor column every week. Want to get something off your chest? Got any ideas for the good of the industry? Your "Citizens Complaint Box" is P. O. Box 1260, Tulsa, Okla.

Number, Please

THE JOURNAL has a new telephone number: LUther 4-4411. Reason: We now have a lot more trunk lines coming into our switchboard. Now you won't get the busy signal so often.

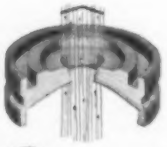
—*Henry D. Ralph*



HERE'S HOW the FLEXIFLOW Variable Valve automatically fills casing from the bottom...

A When casing is lowered, pressure from below causes the hole in the reinforced synthetic rubber disc to open wider, and fluid enters the casing, thus preventing build-up of pressure surges.

B As the rate of lowering the casing is slowed down (to set the joint in the slips) pressure from below decreases; the hole in the Variable Valve diaphragm contracts; fluid volume entering the casing is reduced and overfill is avoided.



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CASING ON BOTTOM SAFER AND FASTER

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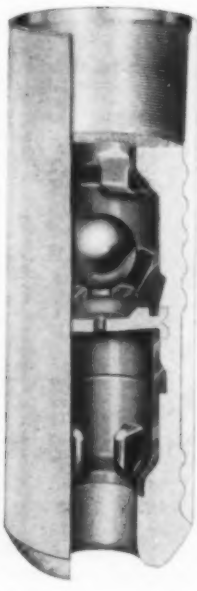

When pressure builds up as casing is lowered in the well, the Variable Valve in Baker FLEXIFLOW Shoes and Collars automatically opens wider and prevents pressure surges by permitting a large volume of fluid to enter the casing. As the rate of lowering is slowed down, pressure from below is lessened and the Variable Valve contracts to restrict fluid entry and prevent overfill. This automatic opening and closing action balances the *rate of fill* with the *rate of lowering* and prevents build-up of dangerous pressure surges.

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SHOES AND COLLARS

The imports plan needs constructive suggestions

SUCH comments on the administration's plan for allocating imports of crude oil as have been made public to date do not greatly enhance the oil industry's reputation for broad-minded statesmanship.

Chief endorsements have come from those refiners who see their individual profits increased by it. Some of those who stand to lose have been highly critical but have not offered any practical alternatives.

The plan is still tentative, and the industry has been asked to suggest improvements. It is to be hoped that come constructive ideas will be submitted before the period for revision expires.

THE IMPORTS POLICY has been set by Congress. People dissatisfied with the principles laid down should not vent their displeasure on Captain Carson, whose only responsibility is to administer them.

The pending allocation plan does not attempt to cover all problems of oil imports, and it should not be attacked for omitting matters reserved for later consideration. The subject is too complicated to ingest with a single bite.

The plan is an attempt to solve the really knotty problem of apportioning crude imports among refiners. This problem would exist whether total imports were high or low. A quota system is what we now have, so it is to the advantage of the entire industry to make its mechanics operate as smoothly as possible.

The solution proposed is a straight mathematical formula, giving every refiner the same percentage of the total. This has the very big advantage of being simple to administer and free from political influence. But while it is entirely workable, it is not entirely equitable.

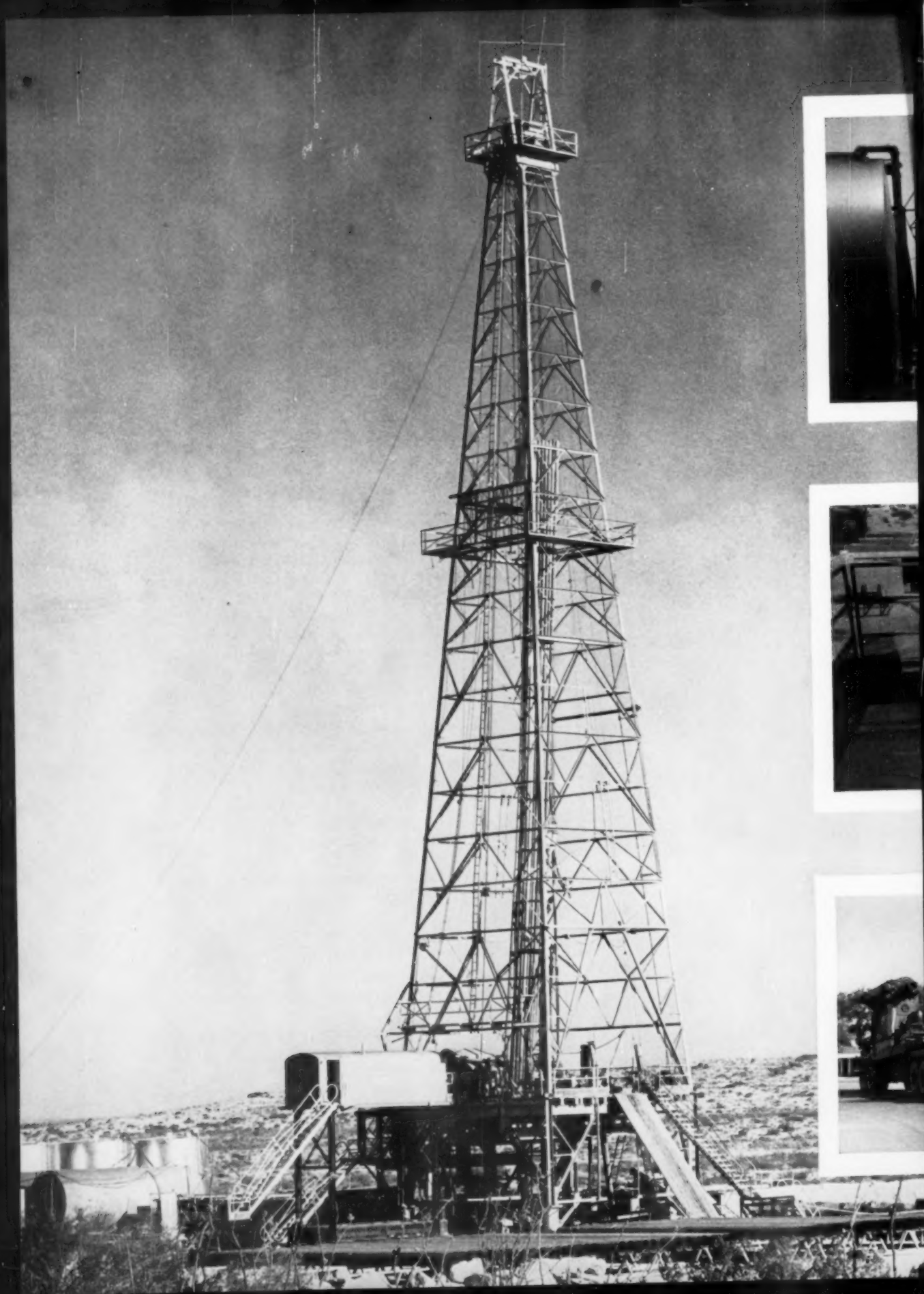
The biggest inequity would seem to be that those refineries and those areas historically and geographically dependent on imports get no better treatment than those which never have used foreign crude and perhaps never will.

Some compromise formula should be possible which will retain administrative simplicity and yet give somewhat more recognition to realities and competitive conditions.

THERE ARE BRAINS ENOUGH in the oil industry to develop an allocation formula sufficiently satisfactory to assure voluntary compliance. The inevitable alternative is mandatory federal regulation which is unwanted by anybody.

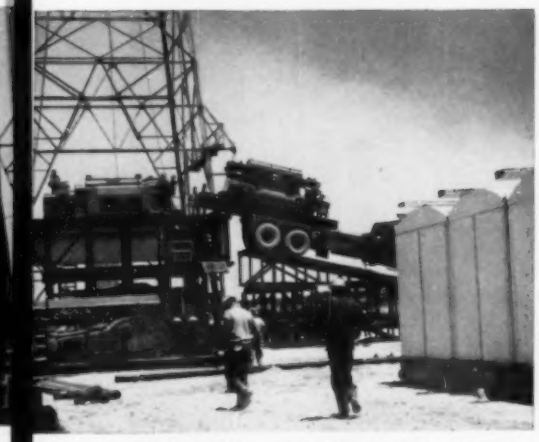
This will take real statesmanship. If sufficient objectivity cannot be expected from refiners with a personal stake in the outcome, it should be attempted by more neutral parties in the industry.

The Government is asking the industry for help on a regulatory problem. It will be too bad if it gets only carping criticism.



Great Western Drilling Company reports . . .

G-E Equipped Rig Drills 23,000 Feet in 364 Days!



RIG-UP TOOK ONLY 3 DAYS, including 125-mile move. Time-consuming mechanical alignment is eliminated with electric drive's flexible cable connections.

GW's Diesel-Electric Rig 44 Handles 600,000-pound Net Hook Load Setting Record 15,868 Feet of 9 5/8-inch Casing

POSITIVE, SIMPLE CONTROL enables GW drillers to drill more hole at less cost. G.E.'s low maintenance drive system reduces down-time to a bare minimum.

GREAT WESTERN'S G-E EQUIPPED RIG HAS SET RECORDS even before completion of one of the world's deepest holes. At Phillips Petroleum & Sinclair Oil Company's No. 1-A Montgomery in Pecos County, Texas, a record string of 15,868 feet of 9⅝-inch casing was recently set. To accomplish this, the rig handled a net hook load of 600,000 pounds, one of the heaviest known loads ever encountered.

ALMOST SIX MONTHS AHEAD OF THE ORIGINAL DRILLING SCHEDULE, Great Western has experienced no significant loss of time due to electrical failure or maintenance. The dependability of the General Electric Drive System has kept down-time to a bare minimum and its inherent advantages have enabled Great Western to drill more hole at less cost.

FOR MORE INFORMATION ABOUT GENERAL ELECTRIC DRIVE, call your nearest G-E Apparatus Sales Office. Drilling offices are located in Dallas, Denver, Houston, Los Angeles, New Orleans, and Tulsa; in Canada: Calgary and Toronto. For overseas requirements, International General Electric drilling offices are located in Bogota, Buenos Aires, Caracas, Maracaibo, Mexico City, New York, and Puerto LaCruz. General Electric Company, Locomotive and Car Equipment Department, Erie, Pennsylvania.

115-26

G-E DRIVE'S PORTABILITY is demonstrated by move time required from Odessa to Ft. Stockton—half that needed for comparable mechanical rig.

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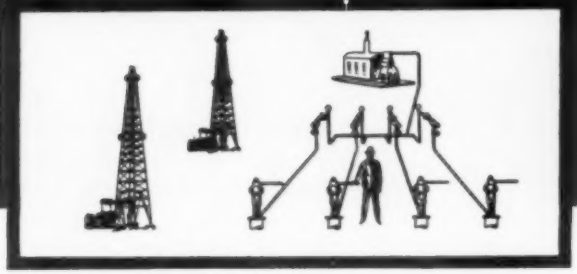

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Looking Ahead at World-Wide Military Fuel Demand

Thousands of barrels daily on a fiscal year* basis

	1957	1958	1959	1960	1961	1962	1963
Avgas 115/145	86	67	92	75	66	60	53
Avgas 100/130	22	19	20	20	17	14	11
Avgas All Other	5	5	5	5	5	5	5
Jet Fuel JP-5	6	5	11	12	14	17	19
Jet Fuel, Other	255	254	331	348	359	367	374
Motor Gasoline	51	42	40	38	36	36	36
Distillate	67	63	61	58	54	51	50
Navy Special	126	107	136	125	122	120	118
Other Residual	41	36	36	36	36	36	36
All Other Products	11	10	11	11	11	11	11
TOTAL	670	608	743	728	720	717	713

*1957 and 1958 figures actual, 1959-63 figures estimates.

Military Fuel Demand to Hit New Peak

• Oil's best customer—the armed forces—will buy 743,000 bbl. per day this fiscal year. That's up 135,000 bbl. from the year that ended June 30. Here's what top Pentagon planners tell the Journal they'll need and how their needs will change in the years ahead.

TWO "IF'S" could bring sharp revisions in petroleum requirements for the armed services.

An economy wave, which caused last year's drop in purchases, could cut back demand. A small-scale war, such as threatened in the eastern Mediterranean, could step it up.

But if neither occurs, the military will need 743,000 bbl. of products per day during the fiscal year that began July 1—22% more than in the year just past.

There's good reason to expect a shift in either direction.

The anticipated $12 billion federal deficit could set off another economy drive. Last year's forced the military to live off inventories, reduce stocks, and cut buying. It is one big reason why this year's estimate of purchases is so high. If it is repeated, 1959 buying would be cut sharply.

Either the smoldering Middle East or the Fomosa straits crisis would tip the scales in the other direction. A "brush-fire" war, with its threat of wider participation, would junk these estimates in no time.

If nothing happens, and present plans go through, 1959 military needs will equal 8% of this year's domestic demand. Most, but not all, will be bought in the U. S. Military buying, therefore, should materially step up the improving tempo of oil.

That's how it looks now to officials of the Petroleum Logistics Division of the Office of Assistant Secretary of Defense.

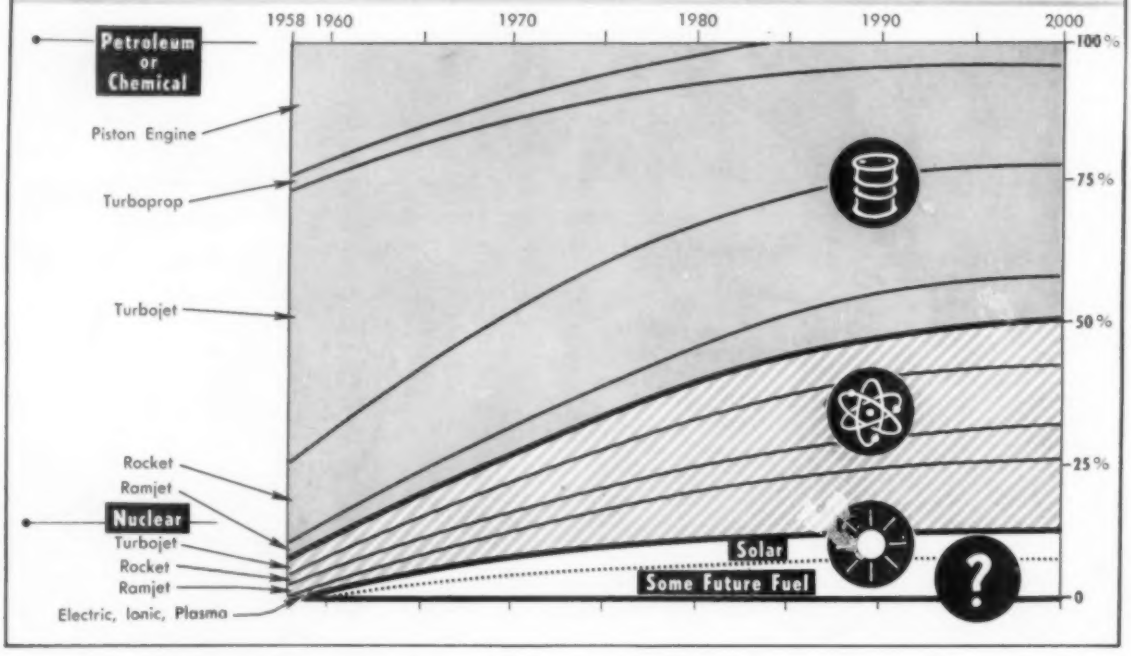
Other concerns . . . With military needs up and likely to stay high, Pentagon authorities show a bit of concern over two matters: Low-freeze kerosine and refining capacity.

Neither problem is yet acute. They could become so if present trends continue.

Low-freeze kerosine is a subject of concern because of the almost unanimous action of domestic air lines in specifying kerosine for their jet fuel. The military would have been less concerned had commercial lines made JP-4 their choice.

The reason is simple. JP-4 is much more available both in quantity and location. Crudes from some of the world's largest producing areas are a poor source of low freeze point kerosine. That's one limiting factor. Another is the prospect of tighter

Where the Air Force Will Get Its Power in the Future



Some Missiles Fueled by Hydrocarbons

Ramjet Missiles (RP-1)

Plover	Martin	Target
Bomarc	Boeing	Surface-to-air
X-7	Lockheed	Air-to-air
Talos	Bendix-RCA	Surface-to-air

Rocket-Engine Missiles (RP-1 + Liquid O_2)

Atlas	Convair	Surface-to-surface
Thor	Douglas	Surface-to-surface
Titan	Martin	Surface-to-surface
Nike-Ajax	Western Electric	Surface-to-air
Jupiter	Chrysler	Surface-to-surface

Jet-Engine Missiles (JP-4)

	Manufacturer	Mission
Matador	Martin	Surface-to-surface
Regulus	Chance Vought	Surface-to-surface
Mace	Martin	Surface-to-surface
Snark	Northrup	Surface-to-surface
Petrel	Fairchild	Air-to-underwater
Firebee	Ryan	Target drone
RP-77D	Radio plane	Target drone

Source: Stauffer Chemical Co.

specs. In time, it could mean relatively few crudes would be suitable and relatively few refineries would be able to produce low-freeze kerosine.

Tight specs are almost certain to rule in the missile field. One authority puts it this way: "The variations in density, the variations in unsaturates, the variations in aromatics, and the variations in viscosity (are) almost intolerable for a ballistic missile which must reach a specified dot in space at a specified time with no margin for error."

Demand for such fuels will not be great. An authoritative source estimates it at something less than 2,500,000 bbl. per year in the next 5 to 10 years. This is about 2% of the current demand of almost 120,000,000 bbl. per year for JP-4 and like fuels. But it could be a high-quality product that only some refineries could make. Making it could lessen, by just that amount, their capacity to produce low-freeze kerosine.

Capacity ample but . . . Refining capacity is ample today and there's plenty of margin.

The trend, however, is to downstream processing with little increase in crude capacity. Authorities concerned with future military needs wonder quietly what the situation might be 5 to 10 years from now. They see this possibility: If a crude-charging capacity goes up at less than 2% per year, and if demand rises at the rate of 4% annually, as some economists foresee, then today's margin of possibly 10% could be wiped out in 5 years.

Both military and civilian demand would jump in the event of war, if World War II is a precedent. Industrial production would go up and, with it, civilian demand for oil. A little-appreciated factor that could cause demand to be higher than ever is plant dispersion.

Dispersal has made and is making factories less likely targets. But it has added to the transportation load. Employes travel farther and so do incoming raw materials and outgoing products. More transportation, whether car, truck or rail, means more oil.

Concern is far from critical in either respect, but supplies of low freeze point kerosine and refining capacity will be watched. In the meantime,

Changes Coming in Fuels for Aircraft, Missiles, and Spacecraft

Type (All Thermally Stable)	Formula, Grade, or Popular Name	Use	Forecast
Aviation Gasoline	80/87 90/ 100/130 115/145	All reciprocating engine aircraft; some ramjet, missiles and helicopters.	Declining as turbines replace pistons.
Jet Fuel (Free-world standardized wide-cut gasoline)	JP-4	All current turbojets and missiles. Future transport and training turbojets.	Gradual increase to 1970 then decline.
Naval Jet Fuel (Free-world standardized high-flash kerosine)	JP-5	Current and future ship-based turbojets and ramjets and missiles.	Not much change.
Experimental High Performance Fuel (HPF) (Narrow-cut, low-volatility distillates or pure hydrocarbons or blends of these.)	JP-6H and JP-?	Future Hi-Mach turbojets, ramjets and missiles.	Gradual increase to 1970 then depend on missile replacement of aircraft.
Rocket Fuel (Narrow-cut distillate)	RP-1	Current rocket missiles and spacecraft boosters.	To be replaced by the next item.
Liquid Rocket Fuels (Special narrow-cut distillates, or pure chemicals or blends of these.)	RP-2 and RP-?	Future rocket missiles and spacecraft boosters.	Gradual increase to 1965. Then stabilize and probably be replaced by storable propellants for operational missiles but remain for spacecraft boosters.
Special Fuels (Chemical fuels.)	SF-1 SF-2 SF-3 SF-?	For current and future special mission turbojets and missiles	Gradual increase. The rest is classified.

NOTE: Fuels not mentioned are small requirement or are being eliminated from use.
SOURCE: Aeronautics Division, Directorate of Research & Development, U. S. Air Force.

the military anticipates no problems in current needs for major products.

Jet demand growing . . . Most important, by far, is jet fuel.

Requirements for the current fiscal year are estimated at 342,000 bbl. per day. That's 83,000 bbl. more than last year and almost 45% of all the military's oil needs. Most of it is readily available, gasoline-base JP-4.

This year's needs will not only exceed those of last year but are expected to grow in the future. It now appears that demand in 1963 will be up to 393,000 bbl. per day. As jet fuel grows, other needs will decline and, by that time, it will represent more than 55% of all military petroleum requirements.

Thermal stability is still the spec that is causing most of the trouble. Its importance is fully appreciated but it doesn't lend itself to ready analysis. It was scheduled to switch from a "requested" to a "must" spec this fall.

Thermal stability can be improved by hydrotreating or with additives. Some of the latter have been helpful in that respect but harmful in another. It adds up to a problem that could become acute as speeds and ceilings impose more severe demands.

Avgas holdings . . . Surprisingly, the gain in jet-fuel demand has not yet cut back avgas needs.

This year they will be well above last year's curtailed purchases and also above those of 1956-1957 fiscal years when there were fewer jets and more money. The accent is a little heavier on 115/145 grade this year. In fiscal year 1959 it represents 79% of all avgas requirements against 73% a year ago.

Avgas demand is expected to drop next year and keep on going down through the rest of the 5-year, 1958-63 period. By 1963 it is expected to be off 40% from today's level. But a need for avgas, in some quantity, is anticipated for another 15 years.

Motor gasoline is one of the few products that will be less in demand than a year ago. It's expected to average 40,000 bbl. per day this year against 42,000 bbl. per day last year. Motor gasoline represents only a shade more than 5% of total demand.

The Army, as the biggest user of

ground vehicles, is the major military user of "mogas." It is looking for longer range and greater fuel economy in ground vehicles. It is working on a 500-hp. compression ignition engine that would operate on gasoline or jet fuel. This engine probably would not require gasoline above the 83/91 octane standard.

The Army is shooting at a degree of standardization. It hopes, some day, to have one compression-ignition fuel and one piston-engine fuel for all its ground vehicles. A reduction in the number of fuels is important logistically when global deployment is considered.

Navy purchases of residual and Navy Special, are expected to be up this year and higher in any of the next 5 years than it was the last fiscal year. The spectacular, but necessarily slow, progress in nuclear-powered vessels means that far down the road atomic-energy ships will replace oil-powered vessels. It's confined to subs now but will be extended to surface vessels. Navy Special demand is expected to slide slowly in the meantime.

6% Rise Seen for Domestic Demand

A 6% INCREASE in domestic oil demand next year is predicted by John C. Winger, petroleum economist for Chase Manhattan Bank.

The economist's 1959 demand forecast calls for gains up to 850,000 bbl. per day in domestic production and 750,000 bbl. per day in refinery runs —if the volume of oil imports remains constant.

Winger also predicted an average 5% increase in demand for petroleum products over the next 10 years.

Winger says inventories of crude oil and products are in good shape and will be "low" by the end of this year. He bases his prediction in part on the expectation that 1959 will be a good year for sale of automobiles.

Missile, space fuels . . . While jet fuel, Navy Special, avgas, and the others make up 99% of the military demand for oil products, fuels for missile and spacecraft are getting the headlines. Despite the headlines on exotic fuels, hydrocarbon fuels are still very much in the picture.

Indications of the importance of hydrocarbon fuels and their value in today's missile picture are shown in Tables 1 and 2. Table 1 lists some of the JP-4 and RP-1 powered missiles. Table 2 compares the critical specific impulse of JP-4 and other fuels with various oxidizers.

Table 3 shows the place of hydrocarbon fuels in today's military picture. Last item on the list is "chemical fuels." They are not defined but there is good reason to believe that some, if not most, of the chemicals that go into these fuels will be petroleum-derived.

Chart 1 is an admittedly "blue-sky" projection of the types of propulsion the Air Force is looking to down the road. Two interesting facts are apparent: The piston plane will be in the military picture for some time yet. Hydrocarbon fuels, as part of the chemical scheme and otherwise, will be around in quantity for a long time to come.

New Petrochem Plant Is on Stream in Louisiana

PETROLEUM Chemicals, Inc., has completed a major step in a multi-million-dollar expansion program started at Lake Charles, La., more than 2 years ago.

The company, owned jointly by Cities Service Co. and Continental Oil Co., has just put on stream a new petrochemical plant designed to produce 200,000,000 lb. of ethylene annually.

About half of the plant production will move through pipeline to other plants in the Orange, Tex., area 30 miles away. The 6⅝-in. line is the first interstate pipeline for moving ethylene. It serves plants operated by E. I. du Pont de Nemours & Co. and Spencer Chemical Co.

Part of the production will be sold to Calcasieu Chemical Corp.'s plant adjacent to the PCI installation. The Calcasieu plant, which manufactures ethylene glycol, was built and is operated by PCI.

Rated capacity of the ethylene plant can easily be expanded by 50% to 300,000,000 lb. per year, PCI officials said.

Ethylene from the PCI plant will be sold to other chemical manufacturers for use in making polyethylene plastics, ethylene oxide, and ethylene glycol. The plant also will produce propylene.

Raw material for the manufacture of ethylene comes from byproduct gases at the nearby Continental and Cities Service refineries and from PCI's ammonia plant.

Petroleum Chemicals was organized in 1954. Its first installation was the government-owned butadiene plant at Lake Charles, which the company purchased for approximately $17,500,000. Capacity has since been expanded more than 25%, to about 79,000 tons annually.

Important Oil Cases Set

. . . as Supreme Court meets. Weighty docket includes tidelands issue, Memphis decision, and price filings.

MORE than 400 appeals from lower-court decisions are on the docket as the U. S. Supreme Court meets this week for its 1958-59 term.

Many of these will be thrown out, in effect affirming those decisions, but enough will remain to make a heavy calendar.

Two issues which are being carefully watched by oil and gas interests were held over from the last term.

Oil men's attention is centered on the Government's suit to limit the gulf states to a 3-mile seaward boundary, giving the United States the rights to all oil, gas, and other minerals beyond that line.

The suit was scheduled to be argued October 13, but the court last month postponed it indefinitely, apparently due to segregation cases.

Memphis case . . . The big issue for the gas industry lies in the Memphis case which involves the legality of rate-increase applications filed by pipelines under Section 4 of the Natural Gas Act.

The case came to the high court last term on appeals by United Gas Pipe Line Co., the Federal Power Commission, and Texas Gas Transmission Corp.

The lower court ruled that pipeline customers' agreements to pay for gas at the contract rate "or an effective superseding rate schedule," do not give the FPC jurisdiction to approve new schedules filed unilaterally.

Texas case . . . Another case held over from last term involves a challenge of Texas Railroad Commission "common purchaser" orders by the Permian Basin Pipe Line Co.

The court below held that TRC orders declaring an interstate pipeline company to be a common purchaser of gas from a field and requiring it to buy ratably do not encroach upon federal jurisdiction or unduly burden interstate commerce.

The company asked the high court to rule whether such orders are in conflict with the Natural Gas Act and to decide if they convert a private purchaser into a common purchaser and impair operation of contracts and deprive the carrier of its property without due process of law.

Price filings . . . Among the cases filed with the court since it recessed last summer are five contesting FPC actions on producer price filings.

The appeals were filed separately by Sun Oil Co., Long Island Lighting Co., Bel Oil Corp., and Union Oil Co. of California.

The lower courts held that evidence that producers' contract rates were set by arm's-length bargaining based on field prices and market value is not sufficient to warrant the FPC finding that the increase sought is "just and reasonable" since evidence of producer costs and rate bases is essential.

The questions here are whether cost-of-service evidence is essential to a finding of reasonableness and whether the FPC can issue a suspension order under Section 4(e) of the Natural Gas Act in cases involving independent producers where price is an integral part of a contract filed as an initial rate schedule.

In another case, involving Magnolia Petroleum Co. and Cities Service Gas Co., a lower court held that an FPC order accepting for filing a producer-seller's initial rate schedule that increased the existing contract rate and was based on the Kansas minimum price order held invalid by the Supreme Court early this year is judicially reviewable under Section 19(b) of the Natural Gas Act.

The court is asked to rule whether Section 19 authorizes the appeals courts to review FPC acceptance of schedules filed in compliance with Section 4(c) of the act.

FPC actions also are questioned in an appeal filed by Oklahoma Natural Gas Co.

The court below held that the commission's failure to make findings on a local utility's objection that a pipeline's proposal to pay independent producers higher-than-market prices for gas was not just and reasonable doesn't invalidate an order granting a certificate but omitting a price reduction condition attached by the hearing examiner.

The question raised is whether the "just and reasonable" rate requirement of the Natural Gas Act bars the FPC from authorizing independent producers' new gas sales without inquiring into an objection that the rates are excessive.

An appeal by Sun Oil Co. challenges the FPC's action, affirmed in the lower court, rejecting 6 rate schedules on gas from its interests in production covered by operating agreements in which others were designated to make sales.

Pauley Forms New Company

. . . to take over far-flung oil interests. Public will be invited to invest through offering of 500,000 shares.

PAULEY Petroleum, Inc., organized under Delaware law last June 2, will absorb substantially all the assets of the oil and gas business which for many years has been conducted by Edwin W. Pauley.

The new firm also will acquire all the outstanding capital stock of Pauley Pan American Petroleum Co. and will secure from Douglas Weatherston a 2½% interest in the compensation payable under a contract with Petroleos Mexicanos.

Pauley will be president of the new company, which will operate producing oil and gas properties, explore and develop its properties, acquire additional oil and gas interests and, through Pauley Pan American, exploit Pauley's Mexican rights.

The aims of the corporation were made known in a registration statement filed with the Securities and Exchange Commission covering 500,000 shares of $1 par common stock to be offered for public sale at a price to be disclosed later.

The statement shows that Pauley, who now holds 1,001,004 common shares, or 69.5% of the stock outstanding, will be given 444,063 shares more for his oil and gas properties, on which the corporation will assume indebtedness of $7,908,351.

Pauley and others will receive 983,399 shares for the Pauley Pan American stock, and Weatherston will get 7,750 shares for his interest in the Petroleos Mexicanos contract.

Pauley Petroleum, Inc., will apply $1,929,000 of the net proceeds from the public sale of the 500,000 shares to repay notes.

Another $3,031,851 will be used to reduce to $4 million the amount of secured notes and to pay the note assumed in connection with the acquisition of Pauley's properties. The balance will be added to the working funds of the company.

How Imports Flowed into the U.S. in August

CRUDE OIL—DIST. 1-4
(Thousands of barrels daily)

	Allocation August 1958	Actual August 1958	Actual July 1958
Atlantic	50.9	55.8	54.0
Bay Refining	2.8	2.8	2.8
Cities Service	28.1	27.3	27.8
Clark	2.0	5.9	0
Continental	5.0	5.0	0
Crown Central	4.3	0	4.4
Danaho	0.5	0.5	0.5
Delta	3.0	9.0*	9.0*
Dow Chemical	0.3	0	0
Eastern States	15.8	54.0	(†)
Gabriel	6.5	6.7	6.3
Great Northern	28.5	30.6	27.0
Gulf	96.3	94.0	96.0
Hess, Inc.	10.0	15.7	0
Ingram	3.5	3.4	3.4
International	10.6	10.6	10.8
Lakehead	0.3	0.2	0.2
Murphy Corp.	4.3	6.8	6.1
Northwestern	11.7	10.0	9.6
Ohio Oil	3.5	5.5	0
Phillips	10.4	12.4	8.7
Pure	5.0	4.8	4.8
Republic	4.0	8.0	0
Shell	6.5	2.1	3.1
Sinclair	53.7	52.9	54.8
Socony Mobil	57.9	57.9	59.0
Southwestern	2.5	4.1	0
Standard of Calif.	57.7	53.0	50.0
Standard of Indiana	25.7	28.4	22.2
Standard of N.J.	62.1	63.1	63.2
Standard of Ohio	7.1	0	11.0
Sun	43.5	55.8	37.1
Tennessee Gas	3.5	4.2	5.9
Texas Asphalt	2.0	2.0	0
Texas City Refining	4.0	0	4.1
Texas	47.0	48.0	47.5
Tidewater	29.5	27.4	17.5
United	3.0	3.3	5.6
Total	**713.0**	**769.2**	**653.0**

*Estimated †Not Reported.

CRUDE OIL—DIST. 5
(Thousands of barrels daily)

	Allocation August 1958	Actual August 1958	Actual July 1958
Bankline	2.3	2.3	0
Caminol	2.9	2.8	3.0
Century	(*)	(†)	0
Douglas	4.5	4.6	0
Edgington	2.9	1.5	2.4
Envoy	(‡)	0	0
Fletcher	5.3	7.8	0
Golden Eagle	2.3	4.0	0
General Petroleum	24.5	21.0	20.8
Hancock	4.0	0	0
Manespo	(§)	0	0
Macmillan	2.4	2.3	2.4
Mohawk	3.0	0	0
Richfield	8.8	12.4	8.4
Rothschild	2.7	5.7	0
Shell	31.3	34.6	21.5
Standard of Calif.	28.5	29.4	26.1
Sunland	2.4	3.2	0
Texaco	19.8	20.4	19.6
Tidewater	36.5	23.0	50.4
Union	11.9	10.5	10.3
U. S. Oil & Refining	7.7	0	0
Wilshire	17.4	22.7	11.5
Total	**221.1**	**208.2**	**176.4**

*Allocation 1500 B/D effective 8/27/58
†Not Reported
‡Allocation 1200 B/D effective 8/17/58
§Allocation 1400 B/D effective 8/13/58

UNFINISHED GASOLINE, OTHER UNFINISHED OILS
DIST. 1-4
(Thousands of barrels daily)

	Average May-June 1958	Actual August 1958	Actual July 1958
Atlantic	5.7	0	15.6
Cities Service	0	3.2*	0
Crown Central	5.6	0	0
Eastern States	12.3	17.9	(†)
Gulf	16.3	16.1	15.9
Hess, Inc.	25.3	0	0
Sinclair	7.3	6.5	6.3
Socony Mobil	19.7	6.6	21.9
Southwestern	4.1	4.4	12.3
Standard of Calif.	8.5	17.9	11.5
Standard (Indiana)	24.8	33.6	24.5
Standard (Ohio)	1.7	5.9	0
Texas City	7.0	3.7	10.6
Texaco	13.8	4.5	10.9
Tidewater	20.0	12.5	4.3
Union	4.7	0	4.5
U. S. Oil & Refining	2.6	4.3	0
Total	**179.4**	**137.1**	**138.3**

*No quota required for asphaltic residuum imported prior to September 16
†Not Reported.

August Imports Went Over Allocations

IMPORTERS brought in 977,400 bbl. daily of foreign crude in August.

This topped the 934,100-bbl. allocation by 43,300 bbl. and exceeded July receipts by 148,000 bbl., according to reports from Capt. M. V. Carson, Jr., program administrator. August was the first time in 11 months that imports exceeded allocations.

Biggest gains were in Districts 1-4 where the volume spurted up 116,200 bbl. daily to 769,200 bbl. The recommended level is 713,000 bbl. daily.

Imports into District 5 also jumped 31,800 bbl. daily to 208,200 bbl., but

still were under the 221,100-bbl. allocation.

Carson blamed the excessive imports on two companies.

"Every barrel of oil over the allocation can be directly attributed to the excess imports of Eastern States Petroleum & Chemical Corp. and the Delta Refining Co.," he said. "Both have refused for many months to cooperate in a program designed to strengthen the national security."

The two companies do not file monthly reports with Carson. But Texas Railroad Commission figures show that Eastern States brought in 54,000 bbl. daily of crude in August. This is 38,200 bbl. over its 15,800-bbl. quota. Delta imported 9,000 bbl. daily or 6,000 bbl. over its allocation.

"In total, this excess oil is 44,200 bbl. daily, or more than the over-all average," Carson declared. But he still found satisfaction in one trend: Imports were still 209,100 bbl. daily or 21.3% under August 1957 levels in Districts 1-4.

Carson's monthly report shows that 18 of the 38 quota holders in Districts 1-4 exceeded their allocations. Only two others besides Eastern States and Delta were over by more than 5,000 bbl. daily. These two were Hess, Inc., and Sun Oil Co.

Some changes . . . Small refiners, meanwhile, are proposing a number of changes in the new import program outlined by Carson last month.

They made their wants known last week at a meeting with Deputy Administrator Donald A. Hipkins of the Small Business Administration.

The small refiners urged that:

. . . **Quotas be based** on capacity instead of runs.

. . . **Transition period** during which all quotas would gradually be brought to the same percentage basis be shortened or omitted entirely.

. . . **Exemptions** for importers of asphaltic crude be eliminated.

. . . **Finished products** be brought under the program.

The smaller refiners fear that a speed-up of runs will result if the new quotas are not based on capacity. The result could be another era of excessive gasoline inventories like that which the industry has been trying to correct all year.

The independent operators fear that major companies would stop buying products from them in order to build up throughput in their own inland refineries.

Basing import quotas on capacity would eliminate this danger, they argue. Refiners then could reduce their runs if necessary without suffering a cut in their quotas.

watching WASHINGTON

Bertram F. Linz

• Changes sought in workmen's compensation

ORGANIZED LABOR is readying a drive for broader workmen's compensation laws.

The AFL-CIO will ask Congress next year for a federal law to take the place of present state laws. If it can't get that, it will urge a bill fixing minimum compensation standards.

The main complaint of labor is that weekly benefits have not kept pace with rising wages. But it complains also that insurance companies carrying compensation insurance for employers deal "harshly" with workers. And there is still a large number of workers not covered by compensation.

Here is what labor wants: Compensation for all workers, selection of physicians by workers, weekly benefits of at least two-thirds of average wages during disability, and adequate provision for dependents.

All this and other changes should be provided through an exclusive state fund to provide adequate benefits at minimum cost and safety and rehabilitation programs coordinated with administrative efficiency.

• Pipelines add 80,000 miles in 16 years

SIXTEEN YEARS of federal regulation of natural-gas companies has seen close to $6.5 billion put into the building of nearly 80,000 miles of pipelines.

The certificate provisions of the Natural Gas Act went into effect in February 1942. The first permit issued covered the building of 20 miles of pipeline at a cost of $87,000.

In the fiscal year ended last June 30 the Federal Power Commission approved 337 projects for 4,372 miles of line which, with compressor horsepower, cost an estimated $518.8 million.

This was one-third less in mileage and $97 million less in cost than the projects allowed in fiscal 1957. But an FPC aide pointed out that the pipelines now are doing much to improve their service by connecting with new and additional gas reserves, expanding storage facilities, and rearranging or replacing less efficient and older facilities.

The peak year in pipeline expansion was fiscal 1951. There were only 173 projects—less than half the number in 1958—but they covered 8,695 miles of line and 736,100 hp., costing $725.4 million. After a sharp drop in 1952, pipeline growth resumed with 7,123 miles of line and 582,700 hp., costing $723 million in 1953.

• Coal men attack fuel-oil imports

THE COAL INDUSTRY is chalking up some gains in its skirmish with the Defense Department over the switching of Army post heating plants from coal to oil.

So far it has averted changeovers which would have cost it an outlet for some 200,000 tons of coal a year.

But coal men charge they won't get very far with this drive so long as oil importers resort to "convenient price oscillations" to raid coal's markets.

Residual imports this year have been at almost the 1957 rate and have not reflected the over-all decline in fuel consumption along the East Coast, they say.

Backed by the extension of import control to "derivatives" of crude oil in this year's foreign tract act, the coal industry is ready to demand that the new import program now under study be broadened to include fuel oil.

How JOURNAL EDITORS PREDICT the Future of Oil

[redacted]

Arizona's Black Mesa basin will be the scene of some new major oil fields.

Appalachian basin, scene of nation's first oil boom, will undergo a rebirth of drilling activity—this time in depth.

The Delaware basin will turn up some elephant fields at depths of 25,000 ft.

Canada will solve its market problems. So look for drilling to reach unprecedented heights there by 1961.

Center of gravity in exploration will shift to Rockies.

[redacted]

Accent will be on speed. Within 5 years a 15,000-ft. well will be drilled in 12 days time.

Depth barrier will be broken again. A 30,000-ft. well will be drilled with improved rotary tools.

Tools will be better, but changes won't be revolutionary. Expect a gas-turbine powered rig to make its bow.

Higher pressures will be handled. You can expect a producing well with 15,000 psi. top-hole pressure.

Offshore drilling will perk up. Underwater completions will permit drilling in water 600-ft. deep.

[redacted]

Military pipelines throughout U. S. will link major defense airports to fuel-supply centers.

48-in. pipelines possible within 3 years.

Petrochemical raw materials and petrochemicals will be moved by pipeline along the Gulf Coast within 3 years.

Pipelines, like grocery supermarkets, will deliver

Trends Show All Segments of Oil Face

• This optimistic but challenging outlook is outlined at AAODC's Dallas convention by a panel of Oil and Gas Journal editors. They tell oil men where they'll be working in next decade and with what kind of tools.

ONE FACT seems clear about the next 10 years in oil: Competition isn't going to grow any easier.

Few if any revolutionary techniques or tools are in sight to give their creator a big advantage over his competitor. Changes will be evolutionary, although speedy, with emphasis still on the hard-work and hard-sell approach.

Predictions of things to come (above) were made for the industry by the following members of the Journal staff: Kenneth B. Barnes, vice president and editorial director; Dr. Frank J. Gardner, exploration editor; Ed McGhee, drilling editor; and John C. Casper, economics editor.

The editors also charted some interesting developments which will lead up to the achievements predicted. Let's take a look at them.

EXPLORATION

Oil hunters actually are finding more oil fields than at any previous time.

But these new fields are little puddles compared with those found in the good old days of wildcatting. Up until the 1950's, the domestic industry was accustomed to uncovering three or four major oil fields a year. These were fields with 100 million barrels or more in them. But since 1950 only a half dozen such fields have been found.

The big fields not only are harder to find but also more expensive. For this reason, many operators have moved abroad or into Canada. The oil search there is still expensive, but operators believe the chances of finding a major field are much better.

But there still are some big fields to be found in this country. Current centers of interest are:

... **Four Corners area** is probably the most rewarding theater of oil exploration today.

Two basins feature the area. The San Juan basin is predominately gas with only a few important oil fields around its rim. Paradox basin is an oil jewel. Aneth, estimated good for 250 million barrels, is the principal Paradox field. But a dozen less important fields surround Aneth. Development may yet merge many of these fields into one huge reservoir.

The southern rim of Paradox basin also will get a play following a recent discovery in Arizona. Importance of Humble's 1,044-bbl. daily strike in the Pennsylvanian cannot be overemphasized. It will mean that Arizona drilling will burst wide open in 1959.

... **Rocky Mountains** in general provide the most active region. Several important basins are under intensive investigation. The Green River basin is yielding new gas fields which could rival those of the San Juan basin. The Denver basin, already dotted by a hundred or so fields, will yield many more when geologists solve the underground trickery of its stratigraphic traps. The Williston basin, the largest of all, presently is nearing peak of production. But still much of the basin which extends north into Saskatchewan and Manitoba has not been fully explored. That makes it one of the hottest wildcatting spots going.

... **Anadarko basin,** one of the deepest and perhaps richest of them all, will influence drilling for years. Hugoton gas field has been producing in the northern part of the basin for years, while the rest remained unexplored. Now wildcatters are begin-

a variety of petroleum products to market in next 5 years.

Europe's pipeline-construction activities will boom in the next 10 years.

Production

Arizona will become an important oil-producing state within the next 5 years.

Operators will be pumping 15,000-ft. oil wells, and in 5 years will be artificially flowing oil wells to depletion.

Automation will make giant strides. Look for entire oil fields to be produced automatically.

Additional seaboard states will be producing oil.

Refining

The completely automatic refinery, operated under 100% control of electronic computers, will appear within 10 years.

A new series of plastics will emerge very quickly from oil's research into petrochemicals.

Day of 110-octane gasoline is near. The motor fuel then will be 100% tailormade.

Output of refined petroleum liquids in U. S. will reach 13 million barrels daily by 1965.

Demand

Crude production will set a new record next year, and domestic demand will be up to 11,750,000 bbl. daily by 1965. This will require domestic output of 8.6 million bbl. daily.

Gasoline demand will take its big jump in 1963.

Natural gas needed by the nation for 1965 will be 16.5 trillion cubic feet.

Explorers must find enough oil and gas by 1965 to add 19 billion barrels of crude equivalent to reserves.

Drillers will have to drill about 473,000 wells in the 1959-65 period to find this oil.

Total drilling for 1965 alone should be at least 75,000 wells.

Busy Future

ning to move into the adjoining Hugoton embayment, into the deep central basin, on the flanks and on the southern tip.

And to the south of the Anadarko basin lies the largest undrilled oil basin in Texas, the Palo Duro, a future producer and a future drilling theater.

Future provinces . . . There are still new places to explore for oil in this country.

Dr. Gardner told the drilling contractors these included the Black Mesa basin of Arizona, the Great basin of the west, and Raton basin of New Mexico and Colorado, and even the Atlantic coastal states. All are sedimentary areas possessing the requirements for oil and gas, but none is yet productive.

Possible other future reserves may be found in the vast and deep Delaware basin of West Texas and New Mexico, the above mentioned Anadarko basin, all of the Rocky Mountain basins, and offshore on the Gulf Coast and on the California coast.

American drillers and operators also may participate in the great oil future ahead for Canada. In the next decade, Canada will see a great northward push into northern Alberta, northern British Columbia, up to the Yukon and through the Northwest Territories, right up to the Arctic Ocean.

Geologists believe there is a potential oil and gas area in Canada still unexplored that is about the size of Oklahoma, Texas, and Louisiana combined.

DRILLING

How will oil men be drilling the wells required to test these great oil provinces? Just one way—faster.

Coming developments that will speed drilling are:

. . . **Better combinations** of weight on bit, rotary speed, and hydraulics.

. . . **More use** of air, gas, and water as drilling fluids.

. . . **Lighter,** more portable rigs and pumps.

. . . **Improved** equipment in all categories.

Weights already are getting higher. Some contractors in West Texas are running 70,000 to 80,000 lb. on an 8¾-in. bit and are using from 35 to 40 collars. These are indications of things to come.

But drillers have found that weight on bit alone is not enough to speed drilling. The key is a combination of weight, speed, and hydraulics. One new method to calculate the best combination has been devised by John W. Speer of Shell Oil Co. and has been reduced to chart form for easy use.

As for air drilling, even more improvements will come in the materials available for shutting off water. More information also will become available on areas where air can be used. Even so, there will be many areas where drillers never can use air for drilling. But one trend will be to use air for long sections of hole and then switch to mud where air is impossible.

Other changes coming up have nothing to do with speed. For instance, hole sizes are almost certain to get smaller. Look for 4½-in. casing to become common. In fact, many future wells may be drilled and completed without casing. The tubing will be cemented into the hole as if it were casing. Multiple completions, which are destined to grow in number, also will use the casingless method.

The 25,000-ft. depth record won't stand long, but the average depth of wells probably won't take a big jump. More wells will be drilled below 15,000 ft. each year, but the bulk will be shallower than 7,000 ft.

There probably won't be any drastic changes in rigs and equipment. They may be made lighter to gain portability. Trends in pumps may be toward use of more small pumps instead of a few big ones. Bits are sure to improve, and down-hole motors definitely are in the future picture.

Big changes offshore will be of the cost-cutting variety. Best economy in sight now is the underwater completion of wells.

PRODUCTION

Emphasis in oil production for the next few years will be on automation and improved recovery methods.

This is a continuation of the current trend with which most oil men are now familiar. But continued re-

New Blowout-Control Devices Ready

• Industry may benefit from Creole's campaign for flexible blowout control. Successful tests of three new devices outlined for contractors.

FLEXIBLE equipment to bring wild wells under control may soon be generally available to the industry due largely to pioneering efforts by Creole Petroleum Corp.

Creole now has on hand in Venezuela, ready for emergency use, three different types of blowout-control devices designed to meet a variety of well conditions.

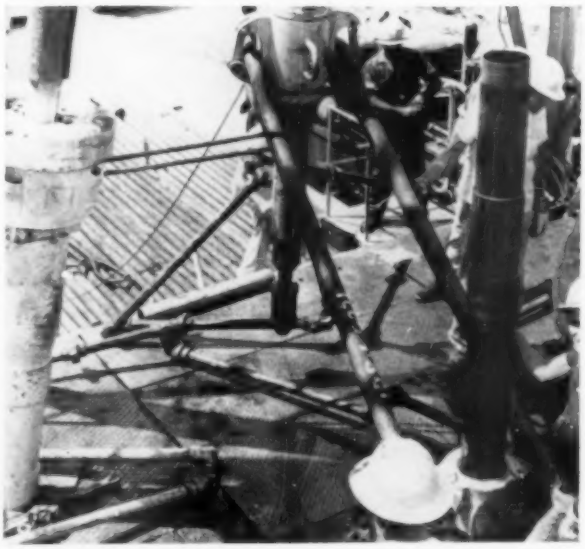
The company helped develop these devices to fill what it felt was a gap in the frontline in the industry's battle against blowouts.

It felt that present blowout preventers are highly efficient and seldom to blame when blowouts occur. It goes along with expert estimates that 95% of all blowouts result from human error—this in spite of intensive programs to prevent them.

Despite all the precautions, when blowouts do occur closure devices generally have had to be tailored from existing equipment elements to fit the situation.

This consumes valuable time. Creole recognized this and set to work to develop control equipment which could be applied broadly and brought into play quickly. Creole worked with Jersey Production Research Co., and equipment manufacturers to develop such tools.

The results were reported last week to drilling contractors at the annual AAODC convention in Dallas by W. E. Harrelson and John E. Ortloff.



STINGER-TYPE TOOL is designed for insertion into bore. The stinger is a double-acting cylinder with packer attached to the end of a piston rod. It's attached to the well from the side, out of the path of the blowing stream. Crew shuts off the wild well by raising the tool into a vertical position and applying hydraulic pressure to the top of the piston. This forces packer into the well bore and expands it against the casing. This tool was perfected and is manufactured by Baker Oil Tools, Inc.

search will improve presently known methods which will get wider use.

Lease automatic custody transfer is one of the fastest growing developments in production. Barnes sees entire oil fields being produced automatically within 5 years. The tools and techniques are now being perfected to make this possible.

As for improved recovery, engineers will see two new methods emerge: In situ combustion and miscible phase flooding. Both are now either in the research stage or getting their first good field tests.

PIPELINING

Pipelines are conceded to be the biggest transportation bargain in the world.

Without this economic means of getting crude, products, or gas to market, costs of petroleum products would be much higher to the consumer. The oil industry would probably not be the giant it is today.

The next few years will see growth in all branches of pipelining but the bulk of this expansion will be in products and gas lines. Pipelines now haul about 50% of the refined products and their share of the total is steadily rising. Natural gas soon will be available to every section of the country and feeder and distribution lines ultimately will even expand this market.

In the field of pipeline operations, automation is making strides. By using a combination of radio network and electronic controls, pipelining will become almost automatic.

REFINING

A pattern of growth, which has characterized refining segment of the oil industry since World War II, will continue to prevail.

In fact, refiners have their job cut out for them to get into a position to make 110-octane gasoline and improved lubes and other products which will be required by improved engines.

Best estimates now indicate basic crude capacity of U. S. refiners will increase from the present 9 million barrels daily to nearly 13 million barrels daily by 1965.

In catalytic cracking, the prediction is for building more than 2½ million more barrels of capacity. Catalytic reforming also will continue to climb, although the refiner has reaped the big benefis from this process.

Hydrogen treating is expected to become the refiner's workhorse with a high level of unit construction expected over the next 8 years.

Petrochemicals, meanwhile, have lost a bit of their glamor for refiners because of the high investment involved in tooling up to enter the field. But petrochemicals will continue to receive more and more attention from the oil industry over the coming years.

Petroleum sources now supply 30% of all chemicals. But these petrochemicals command a higher price. They account for more than one-half the total chemical value.

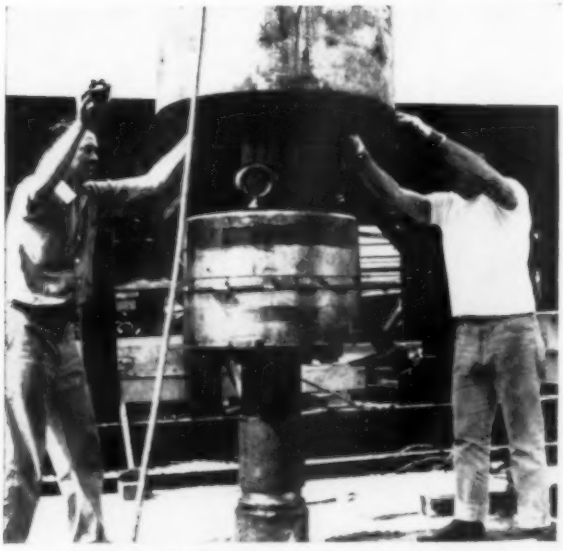
In general, the petrochemical future is this: Conventional large-tonnage products will see further growth but at a lower profit margin. The big challenge lies in new chemicals that are coming along.

DEMAND

One statistical figure is emerging as the most important fact for all oil men. It's the average realization by the refiner for the products he makes from a barrel of crude.

When the refiner's profit margin

to Join Battle Against Wild Wells



LATCH-TYPE OVERSHOT has two basic parts, wrap-around slips and seal assembly and a pressure caisson. Wrap-around units install from the side, grip the casing, and are latched. Overshot with blind ram preventer flanged to its top is lowered over wrap-around and latches automatically. Closing the preventer at the top brings well under control. Fluids can be pumped in through side outlets in neck of pressure vessel. It was designed and developed by McElroy Co. of Houston.

PREVENTER COMBINATION has already been used by Creole to close in one blowout. It consists of a 20-in. Hydril blowout preventer turned upside down, a blind ram preventer, and a spool tying the two together. Here again fluids can be pumped through side outlets to kill the well. This tool was built by Creole. The stinger-type tool is based on a Jersey patent. The latch-type overshot is based on an idea furnished by Jersey. All three have been tested successfully. Creole has trained personnel to operate the equipment.

drops, he must find a way to cut costs. Crude is his biggest expense item. If he can't lower other costs, he must either drop his crude price or go out of business.

Lower crude prices mean a cut in producer's income. When this happens he reduces the number of wells he will drill. Lowered drilling rates, mean some contractor will have to stack rigs.

There is an unbroken chain in the oil business from soft product prices to stacked rigs. And refinery prices will return to normal when crude production and refinery runs can be tailored for a little closer fit with demand.

Outlook for domestic demand is an average of about 9,000,000 bbl. daily for a gain of almost 2.3% over last year. For next year domestic demand is expected to show a gain of about 3.75%.

Production, meanwhile, will be about 7,300,000 bbl. daily in the fourth quarter of this year. Despite this increased rate, low levels of production from March through July will result in a 5% drop for the year from the record set in 1957.

The 1959 outlook is better, however. Production for the first quarter is expected to be a little above 7,300,000 bbl. daily and during the year crude producers again will set a record.

The effect of stepped-up production will be felt on drilling. For this year, drillers will be a few hundred wells shy of their announced 1958 goal of 48,950 wells. But drilling will pick up next year.

Preliminary projections made by Journal Economist Casper point to a drilling program of 54,000 to 56,000 wells for 1959. Basis for this prediction is this:

Gross income from crude and natural gas is expected to reach about $9.6 billion next year. That much gross income will support a drilling program of about 58,000 wells and the declining ratio of reserves to production indicates that number of wells will be needed.

Past correlation between gross income and drilling shows that the chances are about 68 out of 100 that completions won't drop below 54,000 wells if gross income hits $9.6 billion.

Casper said that until more reports are received on operators' plans for 1958 he will stay on the conservative side of the projection and predict between 54,000 and 56,000 wells.

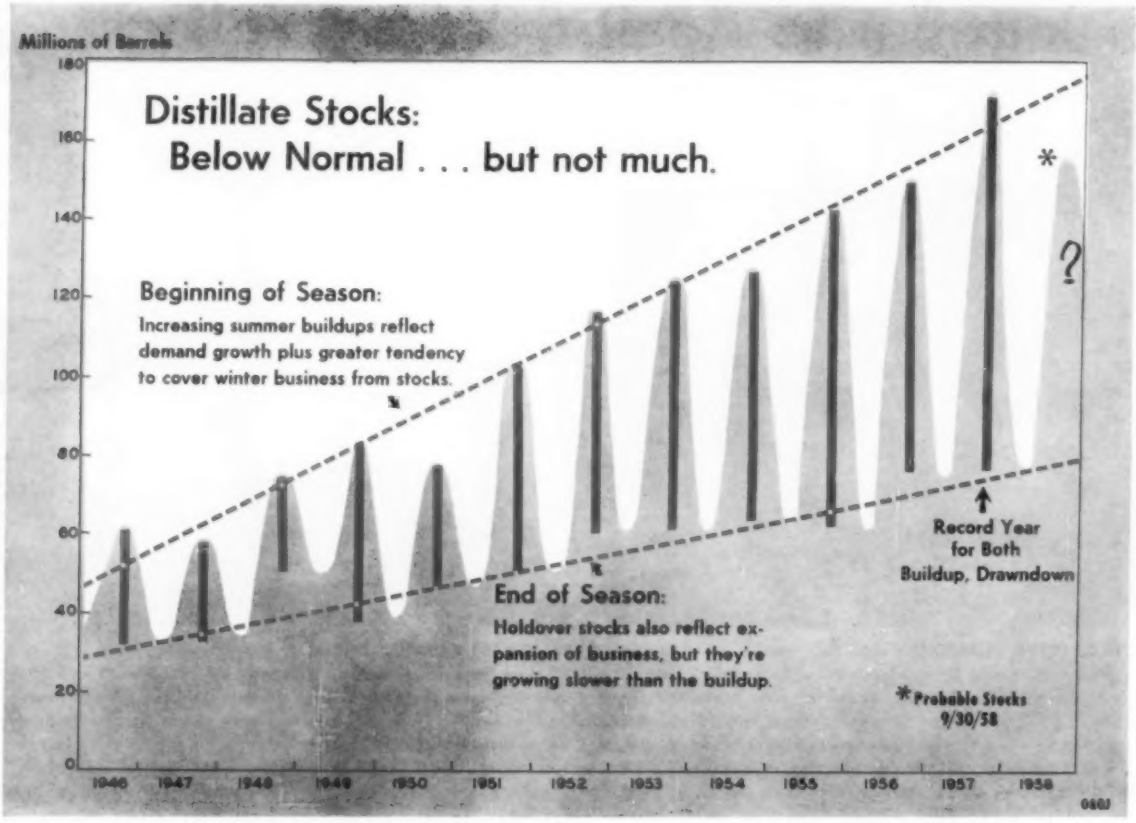
Long-range outlook . . . Producer income also is a factor in the long-range forecasting of drilling.

The economics of drilling works like this: Demand helps determine production. Production and prices set producers' income. And, income calls the drilling tune.

Now take them separately and see what will happen.

Demand depends on two factors: Number of people using oil products and average consumption per user. Both will increase in the years ahead. The result will be an average annual gain in crude of about 3.8% yearly in demand. This means about 11,750,000 bbl. daily by 1965, and an accompanying 50% increase in natural-gas production.

To achieve this production and build up necessary reserves will require more than 470,000 wells for the 7-year period. And the total drilling for 1965 alone should be at least 75,000 wells.



"Low" Stocks Don't Mean Shortage

● Deception comes from abnormally high inventories last year. Distillate growth trends reveal more refiners are using big summer stock buildups to meet winter demand.

MARKETERS may be fooled by the apparent low level of distillate stocks.

The trouble is they look at present stock levels and compare them with levels existing at the start of the heating season last year.

What they forget is that the 1957 levels were abnormally high, and the comparison makes distillate stocks this year appear extremely short. This appearance, in fact, has tended to firm up the distillate market in early movements so far this fall.

Current stocks in recent weeks have been running about 17,000,000 bbl. behind last year. But they still are slightly above levels at the start of the 1956 heating season and a little less than the normal expected for 1958 from market growth trends.

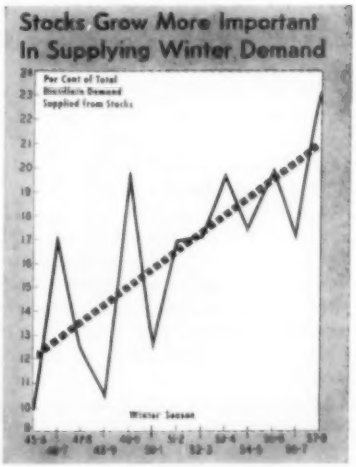
What happened . . . The present situation in distillate stocks stems from interesting developments in the market starting in late 1956.

Stock withdrawals were good until February 1957. For the next 2 months, however, demand lagged and left inventories on the high side at the end of the 1957 heating season.

Then followed one of the biggest stock buildups for a 6-month's period on record. This buildup was constant through the spring and summer of 1957 to the end of September, when stocks reached 176.4 million barrels.

Luckily for the industry, this buildup was followed by the largest withdrawal ever reported. Cold weather late in the season sent stocks by the end of March to 75.3 million barrels, slightly lower than the year before.

The usual heavy summer buildup then didn't take place this year. High gasoline stocks early in the year forced refiners to cut crude runs during the spring and summer months. This reduction in runs, plus lower percentage yields of distillate, resulted in a slower buildup in distillate stocks.


Stocks Grow More Important In Supplying Winter Demand
Per Cent of Total Distillate Demand Supplied from Stocks
Winter Season

These sharp 2-year gyrations stand out in the chart. It shows the present stock level not too far from normal. If severe winter weather comes early, refiners can turn out distillate to re-

place stocks. If another late cold spell hits, stocks will meet needs until refiners can increase runs.

Growth trends . . . The chart also shows how distillate storage has grown since World War II and particularly since 1951.

The top trend line shows the rise of stocks as of September 30 each year. The bottom trend line represents end-of-winter stocks or inventories on March 31. Amount of distillate taken out of storage from October 1 to March 31 each year is shown by the heavy bars. The vertical distance from the bottom of one bar to top of the following bar indicates amount added to storage during the summer season.

The sharp upward trend of the top line means refiners have been building larger backlogs of distillate stocks during the summer to help meet the ever increasing demand during winter. Slight slope of the bottom line shows that carry-over stocks also are increasing at the end of March.

The cone-shaped area between these lines shows that winter withdrawals have been growing but not as fast as summer buildups. This would be unbearable if it weren't for another trend: Refiners are depending more and more on storage to meet growing winter distillate demand.

This situation is pictured in the lower chart where the per cent of distillate demand supplied from storage is shown. Result is a saw-tooth line, but the calculated trend is on a definite rise.

More than 23% of last winter's distillate demand, for example, was met by material taken out of storage. For the winter of 1948-49, only 10.6% of total consumption was taken from inventories.

If this trend continues, refiners will have to add to storage capacity.

Prices Posted in Rockies

SHELL OIL Co. posted its first prices last week for crude oil produced from various fields in Montana, North and South Dakota, Colorado, and Nebraska.

The postings became effective October 1. Fields covered are along the Butte Pipeline and in the Denver basin.

Postings for crude from 40 to 44.9° gravity are $2.635 per barrel for Glendive, Montana, field; $2.77 for Richey and Southwest Richey fields in Montana; $2.70 for other fields in Montana, North and South Dakota; and $2.98 for Denver-Julesburg basin.

The JOURNAL Said . . .

50 years ago

October 6, 1908

After blowing for 2 years and 6 months, the unruly gasser on the Gilbert tract, between Caddo Lake and the Kansas City Southern track, a mile south of Oil City, La., has been plugged. A standing offer of $5,000 was made by the Caddo Gas & Oil Co. to anyone who would shut off the gas. A few days ago a farmer happened along to look at the crazy gusher. He constructed a large metal ball and filled it with cement. After getting everything in readiness, the ball was rolled into the crater and landed over the orifice of the drill hole, and the trick was turned.

M. W. Bahan has obtained franchises to pipe Wichita Falls and Henrietta, Tex., for natural gas, the supply to come from the Clay County field. A rate of 50 cents a thousand feet is specified in the franchises.

25 years ago

October 5, 1933

Secretary Ickes, of the Department of the Interior and oil administrator, is reported slowly moving toward fixing the price of gasoline sold at service stations, and he will fix the price unless oil companies discontinue price cutting. Today reports of price cutting continue to pour into the oil administrator's office.

The confidence of Gulf Coast operators in the belief there remain additional large potential oil reserves yet to be uncovered in this district is reflected in the continued intensive geophysical exploration under way on the coast. . .

For the past year and a half and more the Gulf Coast has been in the midst of what has gone on record as the most widespread and general wildcatting and exploratory play ever witnessed by the industry. Geophysics, although possibly not being given the attention or recognition due it, has been one of the most important phases of that play.

10 years ago

October 7, 1948

The State Department is not taking the seizure of Standard Oil Co.'s Hungarian subsidiary lying down, but officials privately admit there is nothing effective that can be done now.

The drilling contractor is today taking a long-hard look at his financial position, both present and future. While not going broke under normal circumstances, he is at the same time operating on a profit margin believed on the whole, hardly commensurate with the risks he takes and the outlook for high replacement costs of his present equipment.

The oil operators of this country plan to drill more than 22,000 wells and 77,000,000 ft. of hole in the last half of this year to better the record for the first half and to set an all-time high in drilling activity.

Injection to Start

at Tioga and Beaver Lodge. Huge recovery is expected.

AMERADA Petroleum Corp. will begin pouring 24,000 bbl. of water daily into North Dakota's big Beaver Lodge and Tioga fields next month.

The injection will mark the beginning of the Williston basin's first major pressure-maintenance program. Amerada is operator for 21 companies in the two units, the first ever authorized by the state.

Operators hope to hike ultimate recovery from an estimated 132,000,000 bbl. through primary means to an estimated 258,000,000 bbl. through water injection. This is about 72% of the estimated 358,000,000 bbl. of original oil in place (OGJ, Mar. 10, p. 89).

As of last January, the two 7-year-old fields had produced 35,300,000 bbl., or only about 10% of the oil in place. The program will affect only Madison lime.

Injection plan . . . Initial injection will involve seven injection wells in Tioga and six in neighboring Beaver Lodge.

Company engineers estimated that at peak injection—not expected for several years—93,000 bbl. of water will be injected daily into about 40 wells. Injection water will come from the Dakota-Lakota series at 4,800 to 5,500 ft. This will be supplemented by produced water.

The program will encompass 40,436 acres involving 458 wells. The water will be injected at the edges of the fields, pushing the oil toward the center. Unitization was approved by the state industrial commission last March.

Arkansas Fuel May Divide

CITIES SERVICE Oil Co. has filed with the Securities and Exchange Commission a plan to divide Arkansas Fuel Oil Corp. into two separate companies. Each would constitute a complete operating entity.

Under the plan, Cities Service would exchange its majority shares of Arkansas Fuel Oil stock for one of the two companies. The other company would be owned by minority shareholders.

Company officials said the plan for division complies with a SEC ruling requiring Cities Service either to dispose of its majority interest in Arkansas Fuel Oil shares, or to eliminate the minority interest.

MORE STORAGE to handle the critical buildup in fuel-oil inventories is being arranged by Standard Oil Co. of California. Company has started repairing this huge 3,100,000-bbl. reservoir near its El Segundo refinery, empty since 1942.

Gas Blamed for California Crude Cuts

- **Prices of fuel oil and heavy crude reduced to halt inroads in market.**

A MINOR tempest is raging in California over whether natural gas is killing the market for fuel oil and heavy crudes.

The argument started last week when Standard Oil Co. of California, reduced its selling price for fuel oil by 35 cents a barrel and cut posted prices for heavy crude.

The cut in heavy crude prices ranged from 50 cents a barrel for 14°-gravity oil to no change for 27° gravity.

This cut represents a 30% drop in prices for 14°-gravity crudes since March. Typical is Signal Hill field's 14°-gravity crude. It was $2.67 a bbl. early this spring and now is $1.86 a bbl.

Most of the other major purchasers in California followed suit, including General Petroleum Corp., Union Oil Co., and Tidewater Oil Co.

Standard of California explained its action was necessary because of the heavy inroads into the fuel-oil market by natural gas brought into California from outside states.

The Oil Producers Agency of California, however, immediately took exception. Its president, Richard Von Hagen, declared that fuel-oil price cuts weren't the solution. He said California refiners should install processing units to make more gasoline and less fuel oil from the state's heavy crudes.

How West Coast Resid Demand Is Falling

(Bureau of Mines figures, barrels daily)

	1956	1957	*1958
Railroads	10,511	3,641	2,957
Vessels	74,063	82,748	71,914
Utilities	72,353	69,504	42,956
Smelters, mines, mfg.	60,267	41,291	29,444
Space heating	28,691	27,058	24,172
Oil company use	16,191	12,789	22,732
All other uses	6,724	6,701	6,407
Total Civilian	**268,800**	**243,732**	**200,582**
Military	33,871	23,548	30,430
TOTAL DEMAND	**302,671**	**267,280**	**231,012**

*For first 7 months.

Ruined by gas? . . . Standard of California officials painted a grim picture of a glut in fuel oil.

Natural gas imported into the five western states in 1958 displaced the petroleum equivalent of about 450,000 bbl. daily, the company said. As recently as 1947, this displacement was only 15,000 bbl. daily.

This loss of market, coupled with continued processing of heavy California crude which gives a large yield of fuel oil, has meant a growing fuel-oil inventory.

At present 34,000,000 bbl. of fuel oil are stored on the West Coast. This

is an increase of nearly 13,000,000 bbl. over a year ago.

But the future outlook is even worse. Said Standard:

"More disturbing to the fuel-oil markets are the additional natural-gas pipelines that are now being contemplated for construction into California.

"They would deliver gas in volumes far in excess of the needs of the non industrial gas customers. The resulting excess availability of gas would eliminate additional large segments, if not all, of the market for fuel oil in competition with gas.

"The company's preference would be not to buy any heavy crude at this time, even at the reduced prices. However, we hope these price changes will be helpful in meeting the situation by making heavy oil more competitive.

"If not, the company may be forced to cut back its purchases, although it would be reluctant to do so because of the effect the action would have on a great many small producers.

"It should also be noted that no heavy crude oils are being imported into California, so these imports have no bearing on the present glut."

The reply . . . Von Hagen, however, declared that cutting fuel-oil prices is not the cure.

He said that industrial natural-gas prices are geared to fuel-oil prices. When one goes down, so does the other to remain competitive.

Instead, Von Hagen urged California refiners to install processes which could turn out a higher yield ratio of gasoline to fuel oil. This would enable them to refine the state's heavy crudes without adding to fuel-oil stocks.

Von Hagen insisted if it weren't for imports of light crudes, West Coast refineries would have installed such processing units long ago.

The demand picture . . . What's happened to fuel-oil demand on the West Coast is shown in the table.

Total current demand is running about 71,000 bbl. daily behind 1956 and 36,000 bbl. daily behind 1957.

Biggest drops are in use of fuel oil by utilities and by smelters, mines, and manufacturers. In all these areas, natural gas has made rapid gains. Railroads also are using only one-third as much residual this year as 2 years ago.

Military demand for residual had been off sharply during most of this year. But in July about 65,000 bbl. daily was supplied when war tension increased off the China coast. This spurt in demand sent the 7-month average above last year.

Sweet Crude Cut in Oklahoma

. . . by Sunray Mid-Continent. Adjustment lops 14 cents off 40°-gravity oil, more off crudes heavier than 36°.

THE PRICE-CUTTING move by Sunray Mid-Continent Oil Co. last week put the value of Oklahoma sweet crude under terrific pressure.

Sunray's action affected 115,000 bbl. daily.

That's about 20% of Oklahoma's current total production of 560,000 bbl. daily. Sunray is the state's largest purchaser.

With such a big block of Oklahoma crude enjoying a 14-cent plus price advantage, other major buyers are expected to take a similar action.

Sunray in its new postings followed a trend by placing an extra penalty on the heavier crudes. Its price cut was 14 cents a barrel with a 2-cent differential on oil from 44.9° to 36° gravities. Crude below 36° gravity took a 3-cent differential.

Sunray said in a statement that "reductions in practically all principal oil-producing areas have made Oklahoma prices noncompetitive and unrealistic."

"This situation has worsened instead of improving, so we have reluctantly concluded that to remain in a reasonably competitive position, we must adjust the price of Oklahoma crude," Sunray said.

A large bulk of Oklahoma crude suffered a 15-cent cut in the spring but strengthened finally in August. Companies who cut restored the old price after Sunray and some other major buyers failed to go along.

However, since then adjustments downward have been made in many crudes competitive with Oklahoma, including crudes from the Rockies and the Texas-Louisiana Gulf Coast.

Rocky Mountain crudes compete with Oklahoma crude in the big Chicago and St. Louis refining areas. Products made from Gulf Coast crudes compete with Oklahoma refined products in both Mississippi River and Great Lakes markets.

Thus any price changes in these crudes ultimately must be met by refiners using Oklahoma crudes.

Rate Hikes Pending

before FPC keep growing; Total now: $211.5 million.

NATURAL-GAS pipeline companies are awaiting Federal Power Commission action on requests for rate increases which would give them an additional $211.5 million a year.

This was disclosed by a review of applications filed with the FPC over a 24-month period ended last June 30.

The pipelines filed 32 rate increases totaling $95.1 million annually, during fiscal 1957. In fiscal 1958, 33 applications totaling $92.57 million were submitted.

Only $3.2 million of the amount asked last year was allowed without suspension. This was a small percentage, but better at that than the $100,000 approved in fiscal 1957.

The FPC had 31 suspension cases pending at the beginning of fiscal 1957, totaling $134.2 million. During the year it suspended 26 of the newly filed applications, totaling $95 million. It disposed of 16 cases, in which increases of $42.4 million were allowed and $8.8 million disallowed or withdrawn.

This left the commission with 41 cases involving $178 million at the start of 1958. It suspended 22 of the 33 increases filed in that year, amounting to $89.4 million, and disposed of 10 cases in which increases of $31.3 million were allowed and $24.6 million disallowed or withdrawn.

Subsidence Case Is Reset

THE TIMETABLE has been changed in the Government's antisubsidence suit against operators in California's Wilmington field.

Federal Judge Harry C. Westover, hearing the case in Los Angeles, has discarded the previously set October 6 date. Operators now have until 5 p.m. October 20 to file motions for dismissal. Two of the smaller defendants have indicated they will do so.

Hearings on the government request for a temporary injunction will be held January 12. Westover explained it is his personal practice to follow temporary injunctions with permanent injunctions. Thus, more time will be needed for a more comprehensive hearing than is ordinarily required for a temporary injunction.

The Government will ask for an injunction requiring the 121 Class A defendants (active operators in the field) to come up with an approved repressuring plan within 60 days and put it into effect immediately or shut in the field (OGJ, Aug. 25, p. 52).

Atlantic Men Become Teachers

. . . at Texas U. in an unusual course designed to bridge the gap between textbook and actual field operations.

A REQUIRED COURSE for all petroleum-engineering students is setting a new high in industry-education cooperation at the University of Texas.

Eighteen lecturers, all from Atlantic Refining Co., will conduct the semester-long course.

It's the first known instance in which a single oil firm has taken over such a job. The purpose: Give Texas PE students a thorough insight into oil's every-day operational problems.

Besides compulsory attendance of PE students, the class is open to graduate students, faculty members, and undergraduates in other engineering and science fields.

Two-hour lectures are presented each Monday from 4 to 6 p.m. in Texas U.'s Experimental Science Building. Copies of the talks are distributed at each class for study and will be bound into a book at the end of the course in late January. Students must pass a final exam to earn their 2 hours' credit.

Says PE faculty member Dr. George Crawford: "The students get from such seminars something that's just not available to them anywhere else." Oil technology, he says, is moving so fast that textbooks can't possibly keep up.

Atlantic's interest . . . Vern Stepp, Atlantic's chief engineer and coordinator of the seminar, gives several reasons for Atlantic's generosity with its time and talent.

For one thing, Atlantic feels it has a responsibility to help educators. Universities are so much a part of this country's strength, he says, "we feel we are amiss if we don't help any way we can."

Too, such efforts help dignify the oil business and the petroleum-engineering profession, Stepp feels. They also dignify the name Atlantic.

Besides this, Stepp says, the seminar experience will be good for Atlantic's "temporary professors." Engineers, he thinks, are turned too much inward, as a rule. Also, the seminar will make Atlantic's experts better known.

How it came about . . . The idea dates back to an Atlantic educational effort a year ago.

Last October Atlantic men gave a similar, though shorter, program in Dallas for a group of professors in Dallas for an AIME meeting.

Among the professors was Dr. George Fancher, head of the Texas U. petroleum-engineering department. Impressed, Fancher later asked the company to expand the talks, add some, and present them as the seminar now under way. During the summer with Fancher in South America, most of the planning and liaison with Atlantic was handled by Dr. Paul Torrey.

Here's the outline for the course:

Sept. 29—Introduction, Vern Stepp.

Sept. 29—"Offshore's Challenge to the Engineer," J. B. Harrison, offshore operations superintendent, and Lynn K. Williams, production engineer.

Oct. 13—"Proration and the Petroleum Engineer," John Garrett, senior reservoir engineer.

Oct. 20—"Applications of Automation in Oil and Gas Production Operations," D. R. Patterson, production engineer.

Oct. 27—"Well Logging—Today and Tomorrow," A. J. Pearson, senior reservoir engineer, and W. C. Pritchett, research physicist.

Nov. 3—"Tubular Products—Their Design and Application in the Continuing Search for Oil and Gas," S. H. Davis, production engineer.

Nov. 10—"Drilling—1975," R. O. Childers, general drilling superintendent.

Nov. 17—"Corrosion—The Holes in Oil Industry's Pocket," Henry Stiff, Jr., senior chemical engineer.

Nov. 24—"Pattern Sweepout Efficiency—An Important Variable in Reservoir Injection Operations," H. Caudle, senior research chemist.

Dec. 1—"What to Do About Salt Water," Henry Lewelling, senior chemical engineer, and Monte Kaplan, chemical engineer.

L. K. Williams
. . . first in an unusual series.

Dec. 8—"What is Miscible Displacement?" W. F. Kieschnick, research supervisor, reservoir mechanics group.

Dec. 15—"A Frontier in Reservoir Technology: Reservoir Inhomogeneity Assessment and Control," C. A. Hutchinson, supervising research chemist.

Jan. 5—"Natural Gas—The Slumbering Giant," W. L. Bowser, natural gas superintendent.

Jan. 12—"Engineering the Profit Into Gas Well Production," R. E. Fields, senior production engineer.

Jan. 19—"The Digital Computer—What It Means to the Engineer," Paul W. Stade, senior reservoir engineer.

PIPELINE BRIEFS . . .

J. Ray McDermott & Co., Inc., marine and general contractors, has bought a substantial stock interest in Sharman, Allen, Gay & Taylor, Inc., pipeline contractors. The Houston-based companies emphasized McDermott's purchase will cause no change in the policies, management, or personnel of Sharman, Allen, Gay & Taylor. The company will continue to conduct operations as a major land, marsh, and water pipeline contractor.

A 40-mile, 16-in. gas line will be laid by Louisville Gas & Electric Co. between Muldraugh and Magnolia, Ky. Williams Brothers Co., Tulsa, started construction last week. The job, directed by M. O. Thompson, will be completed next month.

A 75-mile, 30-in. loop will be completed next week by Bechtel Corp. on the Tennessee Gas Transmission Co. system from Portland to Centerville, Tenn. Bechtel is also working on two spreads for Transcontinental Gas Pipe Line Corp., both to be finished November 15. They are 64 miles of 30 and 36-in. loops in Pennsylvania and New Jersey and 70 miles of 36-in. loops near Selma, Ala., Billingsley, Ala., Jonesboro, Ga., and Spartanburg, S. C.

Sharman, Allen, Gay & Taylor has completed a 24-mile, 30-in. crossing of Lake Borgne, on the Louisiana-Mississippi border and is working on several other projects. They include 65 miles of 23-in. on the Leidy storage line in Pennsylvania, 115 miles of 30 and 36-in. in Mississippi, Texas, and Louisiana, and two 20-in. lines

AWAITING ORDERS is National Steel & Shipbuilding Corp.'s, yard at San Diego.

California Shipbuilders Ready

. . . for jump in offshore activity. When platform-building picks up, they figure on supplying California firms.

WEST COAST shipyards haven't built a lot of mobile platforms such as are found in the Gulf of Mexico. But they've gained a lot of experience in erecting permanent platforms, designing core barges, and in building supply boats and personnel craft.

Offshore drilling is headed for an upswing, which means more platforms will be needed, and California shipbuilders will be strong contenders for the business.

The number of offshore structures which eventually will be built is still just a guess. One recent estimate is that 75 multi-well platforms will be in use of California in the next 25 years.

Major shipyards at San Francisco, Los Angeles-Long Beach area, and San Diego have been making preparations for offshore work for several years. These include:

. . . **Pacific Coast Engineering Co.,** Alameda, has widened its ways and is preparing for further expansion. It recently completed a 300-by-120-ft. platform for a 700-ton DeLong-type barge. Four legs are now being installed at a Sausalito yard.

After it is completed, it will be tied up about 1½ years laying an offshore sewage line, then it is expected to be converted for offshore drilling service.

. . . **Todd Shipyards Corp.,** which has a huge yard at San Pedro in Los Angeles harbor. Todd has an arrangement with J. Ray McDermott & Co., Inc., to built McDermott platforms.

. . . **National Steel & Shipbuilding Corp.,** San Diego, the only West Coast yard which has constructed a permanent platform. National built the tower for the two-well platform Standard Oil Co. of California is now using at Summerland.

. . . **Moore Dry Dock Co.,** Oakland, which worked on some of the offshore core boats used in California waters. Moore constructed the caissons on both the San Francisco-Oakland Bay bridge and the Golden Gate bridge.

. . . **Bethlehem Pacific Coast** Steel Corp., which has one of the largest yards on the Pacific Coast at San Francisco. Bethlehem has had wide experience in large-scale shipbuilding.

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across the Mississippi River, all for Transcontinental Gas Pipe Line Corp. The contractor has a joint venture with J. Ray McDermott laying four river crossings for Shell Pipe Line Corp. and four more for Southern Natural Gas Co. in South Louisiana.

A 48-mile construction program is nearing completion by Manufacturers Light & Heat Co. A. J. Curtis & Co. has laid 41 miles of 20 and 26-in. line in Pennsylvania. The contractor started last week on the final section, 7 miles of 10-in.

Some 28½ billion cubic feet of gas has been purchased by Trans-Canada Pipe Lines, Ltd., from Canadian Chieftain Petroleums, Ltd., discoverer of South Provost gas field in Alberta. The producer, which has 45,000 acres in the area, will receive 13¼ cents an M.c.f. with the price escalating ¼ cent annually. Deliveries will start next year unless Trans-Canada is ready to accept the gas sooner.

The largest supplier to Trans-Canada Pipe Lines has started delivering gas to Alberta Gas Trunk Line, the gathering system. British American Co., Ltd., began deliveries for test purposes on completion of stage two of its sulfur and gas-producing plant at Pincher Creek field, Alberta. Regular delivery of gas from the $25-million plant under a 25-year contract will start November 1. Pincher Creek is to supply an average of 70,000,000 cu. ft. daily during the first year.

A major gas reserve at Rayne field will be connected to the Texas Eastern Transmission Corp. system by a 22-mile, 14-in. line from Opelousas, La. Work will start this month on the line, contracted to Houston Contracting Co. Houston also will start this month on a 12-mile 16-in. line for Texas Eastern in Acadia Parish, Louisiana.

Also for Pipeliners . . .

IN THE NEWS: Pipeline expansion predicted from trends which show all segments of oil industry face a busy future (p. 110) . . . Decision is expected this month in drawn-out pipeline battle over Midwestern gas markets (p. 120) .

A complete list of pipeline construction projects appears in the last issue of each month. New projects are reported weekly in Pipeline Briefs.

PLUS THIS TECHNICAL REPORT: Simple analog computer finds line pack (p. 229).

Midwest Gas Decision Due

. . . this month as FPC agrees to speed up case. Delay would jump price of gas, hold up service another year.

FINAL DECISIONS in the long, bitter battle for the big Midwest gas market will be reached by the Federal Power Commission this month.

The FPC agreed last week to speed up the case at the urging of Midwestern Gas Transmission Co. and Tennessee Gas Transmission Co.

The companies offered two reasons why the usual examiner's decision should be bypassed:

. . . **Quick action** is needed if service is to be provided by the 1959-60 heating season.

. . . **If a certificate is not granted** to Midwestern by November 1, the price of gas to be secured from Trans-Canada Pipe Lines, Ltd., will automatically jump 1 cent per M.c.f. Additional cost may be as much as $18 million over the life of the contract.

The FPC polled the various interests in the case last month to see if they were agreeable to the speedup. Only one of 23 replies was an outright dissent, that from the coal, railroad, and other nongas groups.

The Midwestern-Tennessee applications are among 20 filed by nine pipeline companies in relation to proposed additional natural-gas service in the midwestern and north central states.

Five separate decisions by Examiner Francis L. Hall have disposed of 11 of the 20 applications. But he has not yet ruled on Midwestern's proposals, which include a request for importing up to 204,000 M.c.f. daily from the Canadian company and the purchase of another 204,000 M.c.f. from Tennessee at Portland, Tenn.

The Midwestern project is opposed by Michigan-Wisconsin Pipe Line Co. and Northern Natural Gas Co., which also seek to build pipelines into the contested area. The applications of the other companies relate to the several pipeline proposals.

The FPC explained that it will speed up the case so that whatever permits may be issued will come "in sufficient time to forestall any further, imminent price increase and to prevent any further, unnecessary delay in disposing of the 20 applications."

The action was opposed by Commissioner Arthur Kline as "unwise." And, he added, "because of the exceedingly doubtful legality of our right to waive the intermediate decision procedure, I think it probable that to do so would delay rather than accelerate the final disposition of this case."

The FPC will hear oral argument on remaining issues October 9.

Plastic Liners Developed

A NEW composite plastic pipe, designed for such bottom-hole uses as oil-well liners and casing windows, has been introduced on the West Coast.

Two types of plastic are combined to obtain the special properties required for these down-hole operations. The internal portion is an extruded tube of polyvinyl chloride. Around this is bonded a glass-reinforced plastic section.

The combination results in an inner surface which resists both abrasion and corrosion. The outer wrapper of glass fibers, impregnated with thermosetting epoxy resin, provides the necessary high collapse and tensile strengths required in liners.

The two-in-one plastic type was developed by Sievers Co., Long Beach, using the Bondstrand process of Amercoat Corp., South Gate, to apply the glass fiber-epoxy wrap. Only size currently available is 5¼-in. o.d. The 20-ft. lengths are connected by molded, threaded joints.

PROCESSING BRIEFS . . .

Tar-sand extract may figure in Husky Oil Co.'s new expansion plans for its Cody Wyoming refinery. Present plant capacity of 7,200 bbl. per day will be doubled. Experiments on domestic tar sands indicate Husky can produce extract at less than market value of crude of comparable quality.

New marketers of 100-plus octane gasoline on the West Coast are Richfield Oil Corp. and U. S. Oil & Refining Co., Tacoma, Wash. Tidewater Oil Co. was the first to introduce 100-octane gasoline on the West Coast, putting it on the market early this year.

Contract to build a 1,700-bbl. hydrofluoric acid alkylation unit at Derby Refining Co.'s Wichita, Kans., refinery has been awarded Procon, Inc., Des Plains, Ill. Completion is scheduled by May 1.

Marketing facilities have been expanded in Texas by Phillips Petroleum Co. Phillips has acquired 26 bulk plants, 13 company-owned service stations, and 46 leased stations from Arkansas Fuel Oil Corp. The properties stretched from Corpus Christi through central Texas to Paris in the northeastern part of the state. Cities Service Oil Co. products were previously marketed at the facilities. Cities Service holds 51.5% of Arkansas Fuel stock.

Jet-fuel contracts for 680,000,000 gal. have been let by United Air Lines to five companies. Fuel will be a kerosine type. Suppliers are Esso Standard, Standard of Ohio, Shell, Phillips, and Standard of California. Contract length varies from 3 years for Shell, Ohio Standard, and California Standard to 4 years for Phillips and 5 for Esso. All are effective January 1, 1959.

Construction is under way on the first of six new service areas Standard Oil Co. (Ind.) is building on the Northern Indiana toll road. Total cost is $2 million. The six service stations and restaurant facilities are expected to be open for business by Memorial Day 1959.

Also for Refiners . . .

IN THE NEWS: Military fuel demand will reach 743,000 bbl. per day this fiscal year, up 135,000 bbl. daily from year just ended (p. 103) . . . New petrochemical plant is on stream at Lake Charles, La. (p. 106) . . . Refiners to share in expansion predicted for entire oil industry in next 10 years (p. 110) . . . Current "low" distillate stocks don't mean a shortage. Deception comes from abnormally high inventories last year (p. 114) . . . Oversupply and high inventories force price cuts in California heavy crude and fuel oil. Inroads from gas competition blamed (p. 116)

PLUS THESE TECHNICAL FEATURES: Nelson refinery construction index (p. 216) . . . Sinclair's Corpus Christi HF alkylation unit (p. 224).

World Output Rises

. . . to 17.8 million barrels daily in July. France ends fiscal year with 50% increase over last July.

FREE-WORLD crude production rose for the second straight month in July with a gain of 400,000 bbl. daily.

Western Hemisphere producers made the most headway, led by the United States. Canada was up. Venezuela had its best month so far this year. The Middle East registered another gain, but output was under the March record. The biggest individual increase was made in Saudi Arabia, offsetting a decline in Kuwait.

France's growing production hit 49,400 bbl. daily in July. This included output from France, the Sahara, and Gabon, plus Morocco. The Bureau des Recherches des Petroles said that in the new year $435 million will be spent on exploration in the French Union. Private sources will supply more than $300 million of the total.

TREND OVER THE LAST YEAR

	Western Hemisphere less U.S.	Middle East	Total, Free World outside U.S.
1957			
July	4,076.9	3,998.0	8,847.4
August	3,924.5	3,955.0	8,649.6
September	3,759.6	3,969.5	8,504.6
October	3,758.8	3,878.9	8,435.5
November	3,654.7	3,704.2	8,412.4
December	3,661.7	3,973.6	8,412.4
1958			
January	3,680.4	4,034.0	8,465.6
February	3,798.7	4,057.6	8,662.1
March	3,672.6	4,243.0	8,631.3
April	3,613.5	4,109.2	8,528.0
May	3,582.9	4,087.8	8,468.2
June	3,678.0	4,156.8	8,654.2
July	3,774.8	4,242.2	8,824.3

World-Wide Crude Production: Daily Average in Thousands of Barrels

Country—	July 1958	June 1958	July 1957
Western Hemisphere			
Argentina	92.9	92.9	89.9
Bolivia	9.5	9.5	9.3
Brazil	52.3	52.3	26.6
Canada	475.0	415.1	540.3
Chile	14.9	14.9	11.9
Colombia	123.0	121.9	127.0
Cuba	1.0	1.0	1.1
Ecuador	8.6	8.6	9.3
Mexico	261.2	261.2	235.7
Peru	52.9	52.9	53.2
Trinidad	102.5	101.9	95.1
Venezuela	2,581.0	2,545.8	2,877.5
Total	3,774.8	3,678.0	4,076.9
Europe			
Austria	52.1	52.5	59.8
France	27.7	27.2	27.8
West Germany	87.0	87.9	77.7
Italy	27.9	27.5	29.2
Netherlands	29.1	29.2	30.4
Turkey	5.4	5.4	6.9
United Kingdom	1.7	1.7	1.7
Yugoslavia	9.8	9.2	7.6
Total	240.7	240.6	241.1
Middle East			
Bahrain	40.7	40.4	32.5
Iran*	798.0	794.0	761.0
Iraq†	755.6	755.7	462.8
Israel	1.2	1.2	1.2
Kuwait	1,353.5	1,383.2	1,293.9
Neutral Zone	70.0	70.0	78.1
Qatar	177.0	161.0	158.7
Saudi Arabia	1,046.2	951.3	1,209.8
Total	4,242.2	4,156.8	3,998.0

Country—	July 1958	June 1958	July 1957
Other Asia			
British Borneo	110.0	110.0	120.0
Burma	7.2	7.2	8.7
India	8.5	8.5	9.2
Indonesia	325.0	340.0	317.8
Japan	7.0	7.0	6.2
New Guinea	5.5	3.7	5.9
Pakistan	5.9	5.9	6.1
Total	469.1	482.3	473.9
Africa			
Algeria	11.1	10.7	0.2
Angola	4.0	4.0	
Egypt	65.2	64.7	52.3
Gabon	9.1	9.0	3.5
Morocco	1.5	1.5	1.5
Nigeria‡	6.6	6.6	
Total	97.5	96.5	57.5
Free World			
Foreign	8,824.3	8,654.2	8,847.4
United States	6,571.0	6,341.0	6,873.0
Total	15,395.3	14,995.2	15,720.4
Communist Countries in Soviet Orbit			
Romania	223.0	223.0	220.0
Russia	2,180.0	2,180.0	1,950.0
Others	60.0	60.0	50.0
Total	2,463.0	2,463.0	2,220.0
WORLD TOTAL	**17,858.3**	**17,458.2**	**17,940.4**

*Includes estimated 5,000 bbl. daily from Naft-i-Shah field not operated by consortium companies. †Includes estimated 3,600 bbl. daily from Naft Khaneh field, operated by British Petroleum Co. ‡Test production.

Figures are from reliable industry reports or government sources. Estimates are made where complete reports are lacking.

NEW MOBILE PLATFORM is assigned to Persian Gulf where . . .

Manifa Stepout Is Under Way

. . . near second offshore discovery. Aramco busy probing same structure that yielded new pay zone last winter.

A NEW drilling platform is getting its first taste of action near last year's offshore discovery in the Persian Gulf.

Mobile Platform No. 1 is drilling ahead in Manifa 2, a stepout 4½ miles southeast of Manifa 1. This well brought in the second discovery off Saudi Arabia made by Arabian American Oil Co. Two zones in the "highly prolific" well were completed between 7,715-7,800 ft. and 7,810-65 ft.

The new 800-ton, three-legged LeTourneau platform was ordered especially for Manifa development. It started Manifa 2 after a 10,000-mile, 115-day tow across the Atlantic, through the Mediterranean, and Suez Canal, and around the Arabian Peninsula.

The platform holds a standard 136-ft. derrick, draw works, rotary table, and generators. It was raised 10 ft. above the surface of the gulf. The outfit can drill in water up to 65 ft. deep.

Aramco's barge, Queen Mary, services the platform. It provides storage for mud, fuel, water, drill pipe, and casing, and carries diesel-electric mud pumps.

Manifa structure lies south of Safaniya offshore field, which has offtake facilities to move as much as 175,000 bbl. daily. The new discovery produces 26°-gravity sour crude, the heaviest so far discovered in Saudi Arabia.

The present well is probably looking for the same pay, the Yamamam horizon of Lower Cretaceous, not productive elsewhere in Saudi Arabia. The formation is equivalent to the Ratawi zone in the Neutral Zone. The discovery also encountered oil in the A, B, and C members of the Arab zone. But the D member, which produces 80% of Saudi Arabian crude, was dry (OGJ, Mar. 10, p. 102).

Australian Well Has Trace

OIL SHOWS have been found in a new Australian wildcat, but a formation test of the section had negative results.

Traces were found in samples from 2,900 to 2,965 ft. in 1 Goldwyer. The well is being drilled near Broome by West Australian Petroleum, Ltd. (WAPET), 80% owned by Caltex.

WAPET also had negative results in its latest formation test in 1 Meda in Fitzroy basin. The test was run on a section from 7,510 to 8,450 ft. Two gas shows were encountered further up hole. The best zone flowed at the rate of 100,000 cu. ft. daily (OGJ, Sept. 1, p. 122).

Burma Well Started

after 16-year wait. Wildcat will test Irrawaddy region.

THE FIRST wildcat ever drilled in the Irrawaddy Delta region of Burma has been spudded 50 miles southwest of Rangoon.

The well is at Hteingyun, 5 miles northwest of Kyaiklat. The nearest well is 150 miles north.

Burmah Oil Co. (1954), Ltd., selected the site on the basis of a seismic survey. Exploration in the area started in 1938. Work was interrupted for 16 years by World War II and a local civil war. When parties returned to the field 2 years ago, units of the Burmese Army went along as protection.

Santa Fe Drilling Co. is the drilling contractor. It is using a rig capable of going to 13,000 ft. The site is on the Uyin Chung branch of the Irrawaddy River, and the rig was carried to location by barge. The area is normally under water during the monsoon season, and the camp and rig sites were raised 3 ft. before construction began.

Burmah Oil is drilling another wildcat at Ondwe in Central Burma. The test is south of the old Yenangyaung field.

Libyan Test Drilling

deeper after first show. Bahi sands is the target.

A 21-MILE STEPOUT from a Libyan discovery by Oasis Oil Co. of Libya (Ohio), has had its first show.

Dahra 1 had the show at 3,100 ft. Oasis called it "encouraging," but cautioned that the main objective lies deeper. This is the 32-ft. pay topped at 5,882 ft. in Bahi 1 to the north and west. The Dahra well is believed to be in the same structure. The Bahi sands test at the rate of 500 bbl. daily.

The wells are on Block 32 in Syrtica, with the discovery less than 75 miles from the Mediterranean.

The French last week were drilling ahead in their Fezzan discovery near the Libyan border. Cie. des Petroles Total (Libye) encountered a 75-ft. zone below 4,600 ft. which tested at 8 bbl. an hour. Reports at first indicated the company planned to immediately move its rig to a new location on Block 49. But it has decided to drill ahead (OGJ, Sept. 29, p. 53).

Creole Is Adding Huge Storage Tanks

FIVE GIANT storage tanks are being built by Creole Petroleum Corp. at its La Salina terminal on Lake Maracaibo.

Each of the tanks will be 200 ft. in diameter and 46-ft. high, each will have a capacity of 268,000 bbl. Floating roofs made of double plate will have special seals to prevent escape of gas. Two will be located in the storage yard and three on the platform of the new La Salina terminal. La Salina is Creole's main supply and service base in Western Venezuela.

Moroccan Acreage Awarded

. . . Fort Worth independent. But part of concessions may be challenged by Algeria because of a boundary dispute.

THE FIRST OIL concessions granted to a private company under Morocco's 2-month-old oil law have gone to Ambassador Oil Corp., a Fort Worth independent.

The acreage granted a newly organized subsidiary, Ambassador-Moroccan Oil Co., is in extreme southern Morocco. Some is in regions claimed by both Algeria and Morocco.

Press reports from Rabat last week quoted Morocco's official bulletin in describing three separate tracts granted to Ambassador. They are called Hamada du Draa, Kem-Kem, and Hamada du Guir.

The three blocks are located to the north, east, and northeast of the 30,000 sq. km. (about 11,580 sq. miles) concession recently granted to a joint Italian-Moroccan company, Societe Anonyme Maroco - Italienne des Petroles (SOMIP).

SOMIP received the tract of land which Spain handed over to Morocco earlier this spring. It was once a part of Spanish Morocco to the south. SOMIP will be operated by the Italian Government official oil agency, AGIP Mineraria, with Morocco holding a half interest in the concern.

It is likely that both the SOMIP acreage and at least a part of the land granted to Ambassador will be disputed by Algeria because the boundary between the former French protectorate and Algeria has not been settled in this area.

On the Algerian side of the border, Societe Anonyme Francaise de Recherches et d'Exploitation de Petrole (SAFREP), has had an application on file more than 2 years for almost 27,000 sq. miles of the Tindouf basin.

SAFREP's application also follows the disputed boundary area between the two countries. SAFREP is controlled from France's official Bureau de Recherches de Petrole.

More Activity Seen

for West African area. Two firms are joining search.

EXPLORATION PLAY in Gabon and Middle Congo is due to step up further with the entry of Socony Mobil Oil Co., Inc., affiliates into the West Africa territories.

Mobil Oil Francaise and Mobil Exploration West Africa, Inc., have signed an agreement with Soc. des Petroles d'Afrique Equatoriale Francaise (SPAEF) for joint exploration and development over parts of Gabon and Middle Congo. The areas cover about 6,175,000 acres (9,648-sq. miles). They do not include all of the SPAEF concession, which blankets the coastal region between Spanish Guinea and Cabinda.

The agreement has been submitted to government authorities for approval. Under its terms, cost of exploration and development, as well as any production, will be shared 50% by SPAEF, and 25% each by Mobil Oil Francaise and Mobil Exploration.

SPAEF produces more than 9,000 bbl. daily from the Port Gentil area of Gabon, where output is close to relatively shallow and deep-water shipping facilities. Four fields have been discovered. Pointe Clairette has four sands between 4,000 ft. and 5,000 ft. Ozouri is smaller and is fully developed, producing 2,800 bbl. daily from 3,300 ft. through nine wells. Animba and M'Bega fields discovered last year are under development.

To the south in the Middle Congo, SPAEF brought in a discovery on its first try. Pointe Indienne 1, drilled on a large salt dome, topped 90 ft. pay at 4,440 ft. The well tested 105 bbl. per hour on a ½-in. choke. Porosity was from 10% to 25%, permeability averaged 100 md., bottom-hole pressure was 2,114 psi., and the crude 45° gravity. A 1-mile stepout has failed to find the pay, and is continuing as a deep test.

India's Wildcat Has Punch

A DISCOVERY on the west coast of India has some kick in it.

Romanian drillers had to seal off the wellhead after a 30-ft. gusher flooded the rig. Pressure was reported to be 5,700 psi.

The well is 1 Lunej, 5 to 8 miles northwest of Cambay, a town on a gulf of the Arabian Sea. Latest reports said the horizon was topped at 5,550 ft., instead of 6,440 as indicated earlier. Another show was found at 5,368 ft. (OGJ, Sept. 29, p. 53). Plans are to take the test to 10,000 ft.

CHECKING a map of Ireland are left to right, John S. Miller, Jr., geologist, Roger Messman, George Collins, and C. B. Rinehart.

U. S. Independents Seeking Irish Luck

A CONCESSION covering all of Ireland was to have been wrapped up late last week by two U. S. independents.

In Ireland to complete the deal were officials of Ambassador Oil Corp., Fort Worth, and Messman-Rinehart Oil Co., Wichita, Kans. Ambassador, with the major interest, is to be the operator (OGJ Newsletter, Sept. 29, p. 4).

No wildcatting has ever been done in Ireland, an island covering about 26,000,000 sq. miles, despite existence of known oil seeps.

Messman-Rinehart began seeking the concession after George B. Collins, Wichita attorney, visited Ireland and became interested in the oil possibilities.

Roger Messman, C. B. Rinehart, and Collins formed an Irish subsidiary, Madonna Oil Co. John S. Miller, Jr., company geologist, made initial studies before the group began negotiating for a concession.

Mexico Building Big Gas Line

. . . from Jose Colomo to capital. It will be Mexico's biggest and longest and will use locally made pipe.

CONSTRUCTION has started on a $43 million project which eventually will move nearly half a billion cubic feet of gas daily to Mexico City.

The line, a 490-mile, 24-in. artery originating in Jose Colomo field in the State of Tabasco, is being built by Petroleos Mexicanos, the government oil agency.

The 110,000 metric tons of steel required by the project will be the first 24-in. X-52 cold-expanded API pipe ever fabricated in the country.

Clearing of right-of-way is in progress on the Jose Colomo end of the line. Some pipe has been turned out at the mill and passed tests required before shipment to the project. Completion is scheduled in 18 months, with local contractors handling the job under Pemex supervision.

The line will traverse swampy lowlands, cross several major rivers, then rise abruptly from sea level to 7,300 ft. on the rocky Mexican plateau.

Throughput growth . . . The line is designed to deliver 224,000,000 cu. ft. daily without any compressor stations along the route of the line the first year of operation.

About 175,000,000 cu. ft. daily will be consumed in Mexico City, the rest en route. The second year capacity will be boosted by two 6,000-hp. centrifugal compressor stations. In the fourth year further compression will raise throughput to the full design load of 430,000,000 cu. ft. per day.

This new gas will offset a drop in fuel-oil supply caused by a shift in refinery yields. It also will permit Pemex to use the gas piped from the old Poza Rica fields for repressuring. Mexico City is now supplied by a 150-mile, 20-in. line from Poza Rica on the gulf coast.

Supply . . . Jose Colomo will be the main source of supply, but other gas fields will be tapped along the route.

Jose Colomo has proved reserves of 1.8 trillion cubic feet. Further drilling is expected to boost the total to 2.5 trillion cubic feet, according to Pemex engineers. There is 247,000,000 cu. ft. daily available now. Later development will provide deliverability estimated at 343,000,000 cu. ft. daily for 20 years.

The gasoline plant now operating at Ciudad Pemex in Tabasco produces 250,000,000 daily of residue gas and 14,389 bbl. of liquids. Gas from the absorption plant is boosted from 1,800 psi. to 4,000 psi. for injection back into the field.

Deal in Paraguay

open as Rimrock drops pact with International Products.

A RIMROCK Tidelands, Inc., subsidiary has withdrawn from a 7.5-million-acre concession in Paraguay.

Rimrock's partner in the deal, International Products Corp., New York, revealed in its 6 months report that its arrangement with Rimrock International Co. has been terminated by mutual consent. International Products said it has negotiations under way with other companies on the development of the concession.

International Products' rights became effective January 21 this year. The company already had engaged in livestock and other business activity in Paraguay. Drilling commitments have not been revealed but if they are not fulfilled International Products is subject to a $100,000 penalty. The company has posted guarantees bond with the government. It has also paid $90,000 in advance rental.

Rimrock's parent company, Husky Oil Co., continues to have an interest in 2 million acres in foreign areas, with another 4 million acres under application.

How to get your money's worth from your

DRAW WORKS AND COMPOUNDING TRANSMISSION

BY ED McGHEE
Drilling Editor

THERE ARE THREE STEPS to making money from contract drilling; making an intelligent bid, making hole fast, and keeping costs low.

Bidding and making hole depend on the area you are working. But keeping costs down is the same everywhere. It starts with getting the right equipment, continues and ends with treating that equipment right. To help you to get your money's worth from those important items, the draw works and its compounding transmission, the Journal presents this special section. Its contents come from our talks with successful contractors and manufacturers.

What to look for . . . Price is important, but don't buy on that alone. Watch for these points on a new rig:

Is it adequate for the job? Will the draw works handle all the loads necessary where the rig will be working? Will it do this without too many breakdowns?

Can it be moved easily enough? Will the rig tear down easily, move quickly, and rig up smoothly? Are the draw works and compound portable enough for their size?

Does it handle well? Does the driller have good control over all necessary equipment? Can the crew make a trip without being exhausted? Can the driller see well enough?

Is it flexible? Can the rig take care of unexpected changes in the drilling program? Can it make money drilling wells in another area where depths and formations are different?

Is it safe? Are the catheads and catlines the safest possible? Are there too many places where a man can trip and fall? Are all moving parts well guarded?

How to treat it . . . There are four big points to keeping equipment running trouble-free. These are:

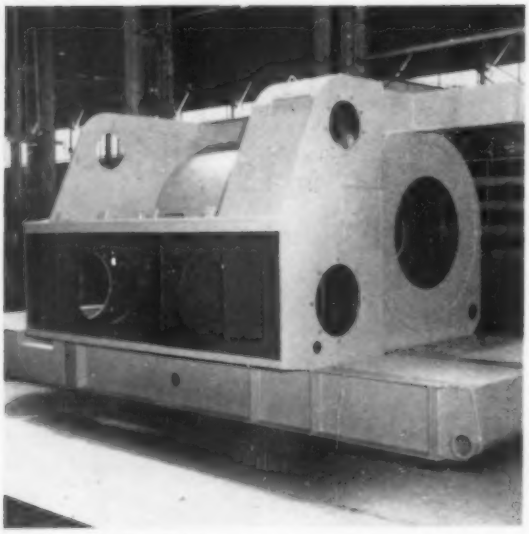
Inspect it. Set up a program so every important item is checked on a regular basis.

Replace bad parts immediately. When one part wears out, it generally puts a big strain on other parts. When your inspection shows something wrong, don't wait to fix it; do it immediately.

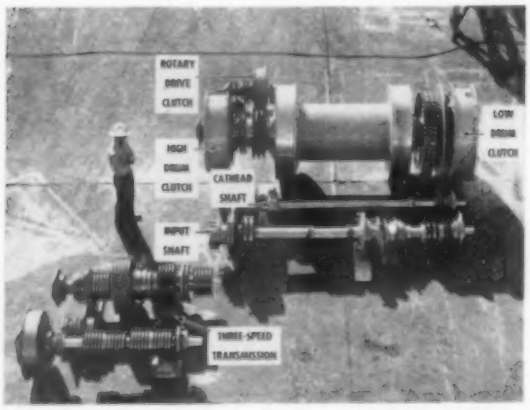
Lubricate it. Know what kind and how much lubricant each piece of equipment needs. Then, see that it gets what it needs when it needs it.

Don't abuse it. Manufacturers make no bones about the limitations of their equipment. Respect these limitations or you'll pay for it in down time for repairs. Be sure there's no rough handling during moves. Clutches and brakes should be engaged smoothly, not with a jerk.

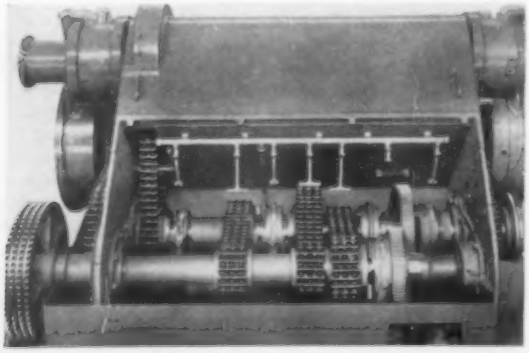
The draw works



DRAW-WORKS FRAME must be sturdy and rigid to keep alignment between parts even during rough handling. Still, there should be working space and easy accessibility to plumbing, etc. Fig. 1.



SHAFT AND DRUM assemblies from a modern draw works. In some cases the rig may have the selective transmission and rotary drive in separate units. Fig. 2.



SELECTIVE TRANSMISSION with draw-works unit. This has three forward speeds but drives to high and low drum clutches give six speeds to the drum. Gears are for reverse. Fig. 3.

MAIN FRAME and side plates of the draw works, shown in Fig. 1, must be utterly rigid. Otherwise, there may be changes in center distances and bearing alignments; and the result would be a lot of down time and repair expense.

To make the frame rigid is not simple; loads of drilling and moving throw big twisting and bending loads on the frame. For that reason it must be ruggedly built and braced, and yet be light enough for easy moving.

Also, the frame should have working space and easy accessibility to the plumbing, control linkage, and oil sumps, if any, under the floor section.

Get big enough drum . . . Fig. 2 shows the shaft and drum assemblies. Like all other parts, these must be well designed and built. Besides this, there are three important things you'll also want to know about the drum itself. Is it big enough in diameter? Is it long enough? Is it grooved?

If a drum is too small for the line, the line will be overstressed and will wear out quickly. For that reason, you should check the rig and wire-rope manufacturers to make sure the drum is large enough for the line you'll use with it.

The longer a drum is (and the bigger its diameter), the more rope can be spooled on it in each wrap. That means fewer wraps will be needed on the drum. And, the fewer wraps, the longer the line lasts. So the drum should be as long as possible without being so long it gives the line a bad fleet angle or makes the draw works too large. Consult manufacturers on this point.

A grooved drum costs more than a plain drum but ordinarily makes the wire line last longer.

Brakes must be efficient, easily adjusted . . . You want your draw-works brakes to stop their load without grabbing; you want them to feed off smoothly without letting go entirely. There are, however, some things to watch for. One is how easily the brakes can be adjusted. If the driller can adjust the brakes easily, he'll do it whenever they need it. This will make the rig easier to operate, and will also make the linings and flanges last longer.

Also, it should not be too difficult to get the brake bands out. If they have to be "wrestled" out, they may become bent or warped.

Check line pull and speed . . . In rotary drilling, usual rule of thumb is that the draw works should have 1 hp. for each 10 ft. to be drilled. It isn't an iron-clad rule. Many light rigs do well with less; many deep-well rigs have more.

But, the important point to remember is that you can't judge a draw works by line speed alone. It's the combination of line pull and line speed that is the real index of a unit's power.

Of course, with internal-combustion engines, we have essentially a constant-speed drive. And, any change in line speed and line pull has to come from a selective transmission. Fig. 3 shows a selective chain transmission for a modern deep-well rig. This trans-

. . . what it is and how to select the right one

mission is much the same as all others used today. It has three forward speeds; two drives (through low-drum and high-drum clutches) to the main drum give six speeds to the line. Fig. 4 shows the speed vs. pull for a modern draw works. Fig. 5 shows the same thing for another draw works driven by engines with torque converters.

The gears in Fig. 3 are for reverse. Two drives to the drum give two reverse speeds to the line.

While this selective transmission is mounted directly on the draw-works frame, some are mounted on separate skids. This makes moving simpler for heavy, extra-wide units.

Do you need a sand reel? . . . A sand reel is seldom used during drilling; mostly it's for testing and completion work. Rigs which drill where many drill-stem tests are made during drilling, usually have an integral sand reel with the draw works. So do rigs which must stay on the well during completion.

Although an integral sand reel is cheaper than a separate, independently powered swabbing unit, it is sometimes better to use the separate unit. Then, the rig can move to a new location sooner. Check the area in which your rig will operate. It may be that the sand reel is not absolutely necessary.

Shaft or chain-drive rotary . . . Most rotary tables are chain driven off the draw works. This chain drive is simple, cheap, easily rigged up, and trouble-free. When properly guarded it is no safety hazard.

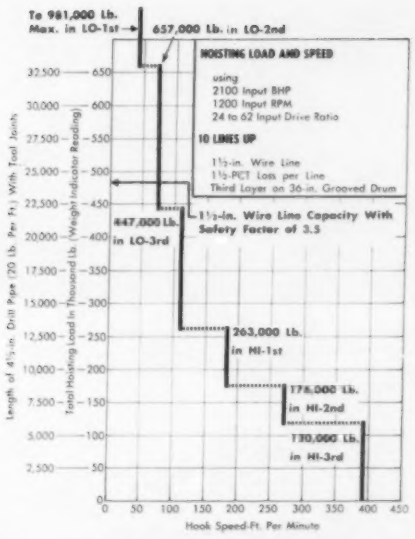
However, many rigs do better with a propellor-shaft drive to the table. This is the case on many light rigs where there isn't room enough on the floor for a chain drive. It is also true on some large rigs where the draw works is in an unconventional position. While the propellor-shaft drive must be more carefully maintained, it does not need replacement nearly so often as a chain. The shock loading of the rotary drive is extremely hard on chains.

The propellor-shaft drive is lower and, many times, can be made flush with the derrick floor. Because it has right-angle gears and bearings, the shaft drive is more expensive and requires more maintenance.

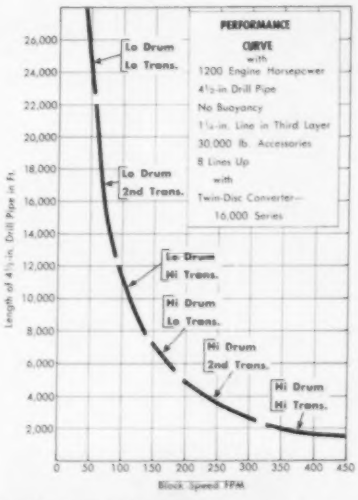
An independently driven rotary has the advantage that all shafts in the draw works can be stopped while rotating. This means longer draw-works life. Moreover, all rig engines can be used on the mud pumps when the rotary has an independent drive.

Is control easy, complete? . . . Air-operated controls reduce the labor of running a rig and speed drilling operations. Be sure your rig takes advantage of these labor savers. The driller should have as much control as practical from his console like that in Fig. 6.

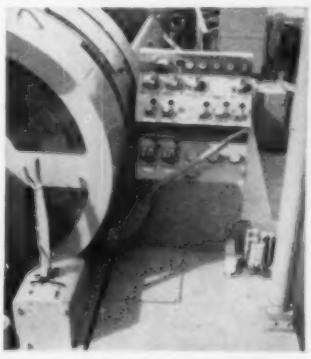
Likewise, the driller should have enough instruments to be sure how his equipment is performing. There should be enough pressure gages, temperature gages, and tachometers to give a complete story on the air supply, water supply, engines, and torque converters.


To 981,000 Lb. Max. in LO-1st
657,000 Lb. in LO-2nd
HOISTING LOAD AND SPEED
using
2100 Input BHP
1200 Input RPM
24 to 62 Input Drive Ratio
10 LINES UP
1⅛-in. Wire Line
1½-PCT Loss per Line
Third Layer on 36-in. Grooved Drum
1⅛-in. Wire Line Capacity With Safety Factor of 3.5
447,000 Lb. in LO-3rd
263,000 Lb. in HI-1st
175,000 Lb. in HI-2nd
130,000 Lb. in HI-3rd
Length of 4½-in. Drill Pipe (20 Lb. Per Ft.) With Tool Joints
Total Hoisting Load in Thousand Lb. (Weight Indicator Reading)
Hook Speed-Ft. Per Minute

HOOK SPEEDS in each of the six "gears" of a modern draw works. Do not judge the draw works on line speed alone. You must compare the combination of line pull and line speed. Fig. 4.



EFFECT OF TORQUE CONVERTERS on the drilling engines. Instead of sharp steps as in Fig. 4, the line pull and speed takes a smooth curve. Efficiency is slightly higher without the shock-absorbing converters. Fig. 5.

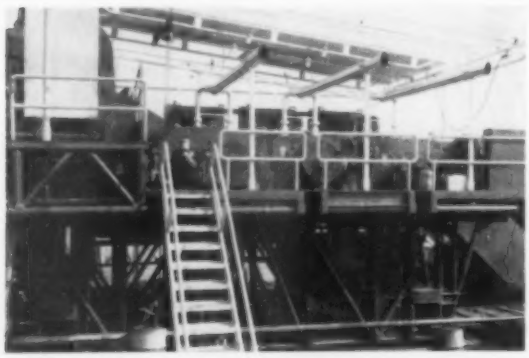


MAKE SURE your new rig is easy for the driller to control. Make sure he keeps it as shining as when new. The result will be more efficient drilling. Fig. 6.

The Compounding

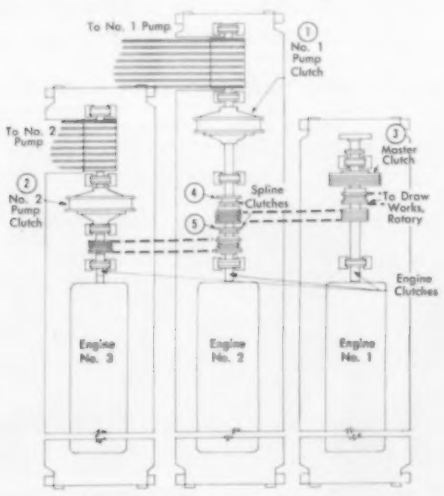
Make sure it's portable, flexible.

DEEP-DRILLING RIG with a one-piece compound. The one-piece construction assures alignment between shafts and sprockets. It helps keep the interior of the case clean. Fig. 7.



TYPICAL SECTION COMPOUND. Each engine skid carries its own section of the compound case. Alignment and cleanliness are a problem, but there's no worry about alignment with engine clutches. Fig. 8.

TO:	ENGAGE CLUTCHES	DISENGAGE CLUTCHES	ENGINES DRIVING		
			No. 1 PUMP	No. 2 PUMP	DRAW WORKS—ROTARY
Compound engines for drilling	1,3,4,5	2	1,2,3		1,2,3
Compound engines for drilling	1,3,5	2,4	2,3		1
Compound engines for drilling	2,3,4,	1,5		3	1,2
Compound engines for hoisting	3,4,5,	1,2			1,2,3
Mix mud while drilling	1,2,3	4,5	2	3	1



HOW A TYPICAL three-engine compound can be changed to perform various chores in drilling. A four-engine compound gives even more possible variations. Fig. 9.

THERE'S AN ADVANTAGE to having an engine compound that comes in a single unbroken case. It isn't necessary to break the chains for a move. Such a compound can be built with great rigidity so there's little chance for parts to become misaligned, or for foreign matter to get into the case. These things make chains and bearings last longer. Moreover, a one-piece compound is usually cheaper to build than other types.

Most small rigs have one-piece engine compounds. The compounds are usually mounted in a common package with the draw works. Even where such packages would be too large for highway moves, they may still be easily enough managed for in-field moves.

While the one-piece compound has little problem with alignment of sprockets, most have problems of alignment with engine clutches and pump-drive clutches. The engines usually have to be transported separately from the compound. And, when the engines are aligned with the compound after moves, a careless job can result in rapid wear on the clutches and bearings. As a result, most rigs with more than 500 hp. use section compounds instead of the one-piece type.

Fig. 7 shows a popular rig which does use a one-piece compound in spite of its 1,500-hp. size. To prevent misalignment, this compound has propellor shafts connecting it to the engines.

Cleanliness, alignment . . . In a sectional compound, each engine skid carries its portion of the compound. Fig. 8 shows a common type of sectional compound. Of course, the sections of the compound have to be disconnected for moving. That is, not only the compound case, but the chains must be broken. Rig manufacturers design the compound case so that the sections can be taken apart and put back together with a minimum loss of time.

There are two main problems with any sectional compounds—these are cleanliness and alignment. Any time the compound case is opened for moving, there's a chance of foreign matter getting into the case. Once in the case, it gets into the oil system and causes great damage to chains and bearings.

Well-designed compounds are rigid enough to prevent misalignment if the substructure is level. The engine skids can be rigidly fixed together with pins, tongue-and-groove couplings, dowel pins, or the like. These devices will keep alignment as long as the substructure is true. So, before setting the engines on the substructure, make sure it is level and properly shored up so that it will not settle badly on a corner.

Taking power off compound . . . Fig. 9 shows a typical three-engine compound. There are usually only two major power demands on the rig compound—the draw works and the mud pumps. The power need of the draw works is intermittent—it needs full power only during the time the pipe is being pulled; actually this is only a small portion of the total time. And, if the

Transmission

Watch pump drives, sprocket sizes

rotary table is powered off the draw works, this takes only a fraction of total available power.

The mud pumps are a different story. They put a steady load on the compound. And, often this load is close to the maximum available. For that reason, the pump end of the compound must be more conservatively designed. The chains should be heavier as in Fig. 10.

Your compound will cost you less if you use the side pump drive shown in Fig. 11. Notice that each of the pumps in this side pump drive gets most of its power directly from an engine shaft; little of the power comes from the chains. Contrast this to a rear pump drive where all of the pump power has to come through the chains, none directly through the engine shafts. As a result of this, a compound driving both pumps off the rear needs wider, more expensive chains. Wider chains mean longer shafts and, thus, bigger shafts.

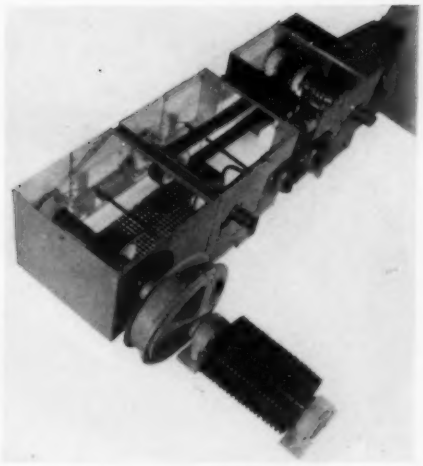
As an example of the difference, one manufacturer makes a certain size compound to go with his 1,000-hp. rig. This compound can deliver a total of 1,400 hp. to the two pumps if they are driven from the side. If both pumps were to be driven at the rear, the chain would limit the amount of power available to only 850 hp. Thus, selecting the rear pump drive would mean buying the next larger compound. The next larger compound (for a 1,400-hp. rig) is designed to deliver only 1,250 hp. to a rear pump drive.

Of course the substructure is simpler if both pumps are driven from the rear of the compound. And, the pumps are easier to connect. However, for most drilling the side drive will be just as good and will be cheaper besides.

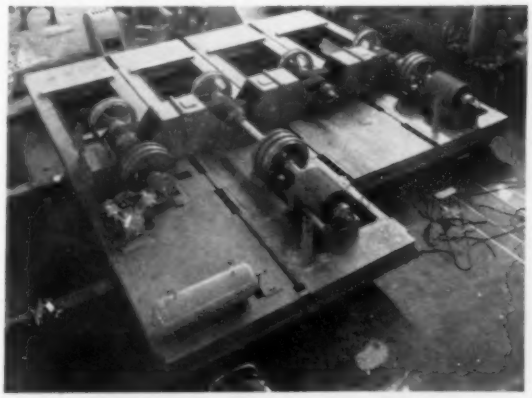
Chain speeds faster . . . Not long back, 3,000 ft. per minute was considered to be the top safe chain speed for rig compounds. Now, however, many chains in compounds run at 4,200 ft. per minute; some even approach 4,800 ft. per minute. In spite of this, chain wear in most compounds is good. The secret lies in the fact that the sprockets are larger and lubrication is better than in years gone by. The larger the sprocket, the less stress it puts in the chains and the longer the chains will last. When comparing rigs with similar chain speeds, you can usually expect the one with larger sprockets to give better chain life.

The fast chain speeds of today have made lubrication even more critical than ever. Lubrication in the compound is more critical than in the draw works where chain speeds are lower.

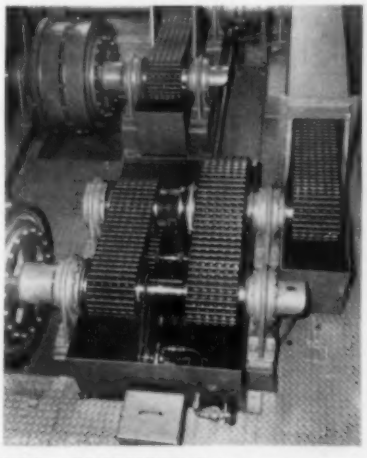
Chains running slower than 2,000 ft. per minute can be lubricated well enough by running through an oil bath. With such a system, the oil level in the case should be such that the chain runs immersed to about the center of the pins. At speeds above 2,000 ft. per minute, the chains must be encased and oil force fed through a circulating oil pump.



A TWO-ENGINE COMPOUND. The draw works put only an intermittent load on the compound. The pumps put on a steady, near-capacity load; for that reason the pump-drive chain must be heavier. Fig. 10.

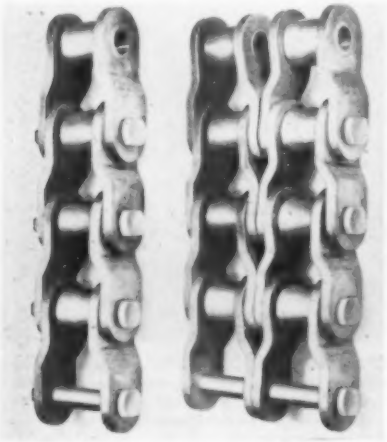


THIS FOUR-ENGINE COMPOUND drives its pumps in step fashion. That is, each pump gets power straight through an engine shaft. This means chains can be smaller than in a two-tail-pump arrangement where all power must be carried in the chains. Fig. 11.

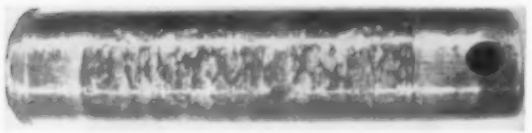


A TWO-SPEED COUNTERSHAFT for a pump drive with oil pump in the foreground and force-feed pipes. Chain speeds in the compound are faster than ever and good lubrication is more critical. Fig. 12.

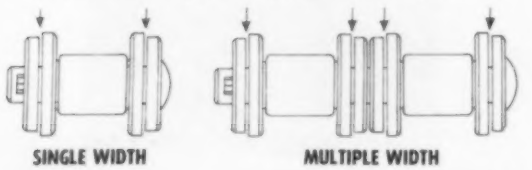
A FOOT of this chain contains dozens of parts. These parts work together as precision machines. They will last longer if well aligned, clean, lubricated properly, and tight. Fig. 13.



API CHAIN was designed for slow-speed drives. It is still used on many rotary drives, which are slow-speed application. Running through an oil bath is usually sufficient to lubricate this type chain. Fig. 14.



Oil Should Be Dropped In Spaces Indicated By Arrows



HEAVY GALLING in a chain pin resulting from poor lubrication. This can be avoided by using enough of a good lubricant at the points shown. Fig. 15.

Chains . . . Lubricate

proper tension, inspect

CHAINS in your draw works, compound, pump drive, and rotary drive are precision equipment. Fig. 13 shows many of the individual parts of a common brand of oil-field roller chain.

API standard drilling chain, Fig. 14, was intended for slow-speed drives. It is still commonly used in rotary drives and in some draw-works drives which are slow-speed applications. But, because of high chain speeds, most drives use ASA (American Standards Association) roller chain. Roller chain is commonly used in sizes ranging from 1-in. pitch through 2½-in. pitch and in multiples up to eight strands.

Use a light oil, keep it clean . . . There must always be a film of oil on the pins and bushings of roller chains. If there isn't, the chain wears out fast. In pressure systems, the oil leads should direct the oil to the points shown in Fig. 15. Along the drive, the best place for the oil feed is on the inside of the slack strand just before it meshes with a sprocket. Centrifugal force will then help spread oil throughout the parts of the chain.

Just because there's oil on the outer surfaces doesn't mean that a chain is properly lubricated. To be effective, oil must get to the pins and bushings. Since tolerances between these parts are close, always use a good grade of nondetergent, low-viscosity, mineral oil that can penetrate the small passages. Usually SAE 20 or 30 grade, depending on temperature, is recommended. Heavy oils and greases can actually seal off the small clearances and prevent pin-bush lubrication.

If dust, dirt, or water gets into the casings and contaminates the oil, repair the casings immediately to make them oiltight. Moreover, drain the oil and refill with fresh, clean oil. Take out the roller chains and clean them in gasoline or kerosine to take out any abrasive material that might have worked into the pin-bush bearings. Such abrasive material will shorten chain life greatly. After the chains are cleaned and allowed to dry, dip them in clean oil before putting them back on the sprockets.

It's a good idea to drain the oil and replace it with fresh oil after a new chain has run about 500 hours. After that, oil shouldn't need changing oftener than every 6 months. Of course, it may have to be changed oftener if its contaminated or extreme weather forces a change in viscosity.

Never use oil drained from the engines.

Suction screens on forced-feed oil systems can become clogged. For that reason, these screens should be removed and cleaned at least once each well. Watch the pressure gage on the oil system. If pressure is too high, check the oil-spray pipes to be sure none are stopped up. If pressure is too low, check the pump-suction strainer and clean if needed; also, check oil level in the reservoir and add oil if needed.

When checking oil level in the chain reservoirs, wait a few minutes after all shafts are shut down; this will allow the circulating oil to accumulate in the sump. Check these oil levels once each tower as a matter of routine.

properly, keep aligned, keep regularly

Watch for angular, offset misalignment . . . Be sure that sprockets are in line with each other. Offset misaligned sprockets—on parallel shafts but out of line—cause excess wear on one side of the driver sprocket and the opposite side of the driven. This offset also puts an unequal loading on the side bars, and the result will be fatigue failure in both outer side bars but not in the inner side bars of multistrand chain.

Don't depend on eyesight alone to align the sprockets. Hold a straightedge along the sides of the sprockets as in Fig. 16 and be sure there is line contact along both.

Equally as important, the shafts must be level and parallel. Angular misalignment—shafts out of parallel—is another cause of unequal loading on the side bars. This shows up as more wear on one side of the chain and sprocket teeth than on the other. The side bars will fail on one side of the chain only.

To check shafts for angular alignment, measure the distances between the ends of the shafts as in Fig. 16. Distances C and C' should be equal. Check the shafts with a spirit level to be sure they are horizontal.

Sprockets must run true, with as little weave and wobble as possble. They must be tight on the shaft, so check that keys are tightly fit in the keyways. Vibration can cause wear of loose keys and key seats. The wear causes misalignment that damages both chains and sprockets. For the same reason, bearings and supports on the shafts must be rigid and kept so.

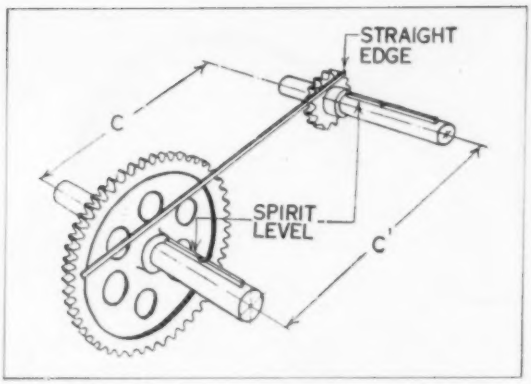
Proper tension lengthens chain life . . . If a loaded chain has the proper tension, the load side will be tight and almost straight. The unloaded side will be loose and will sag slightly. If the chain is too loose, it will follow the driver sprocket as it leaves the loose side and it will pile up in front of the driven sprocket when entering it. The result will be damaged tips on the sprocket teeth and cracked chain rollers. A chain may become so loose that it "jumps" teeth on the sprocket; this puts big shock loads not only on the chains but on all other equipment as well.

To get the proper chain tension, turn one sprocket to tighten the lower strand. Then, measure the sag of the upper strand as in Fig. 18. The sag should be measured midstrand and should be about 2% of the length of the tangent to the sprockets. An inclined drive should have less slack than a horizontal drive.

As it is run, roller chain will gain slack due to stretch from normal wear. When there is enough slack to take out a link, this should be done. However, when a roller chain elongates 3 to 3½ %, it has worn through the case hardness of the pin-bush bearings; it has served its useful life and should be replaced with new chain.

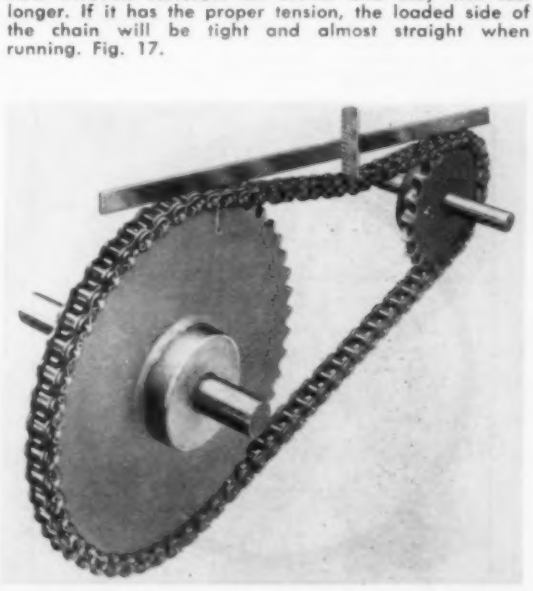
Look for uneven wear . . . After chain has run about 500 hours, inspect it. Inspect it periodically after that. It can be checked for wear without removing it.

Sometimes a new replacement chain will fail much sooner than did the original chain. Usual cause of this is worn sprocket teeth. Sprocket teeth with excessive wear put great stresses in the chain; they should be replaced.

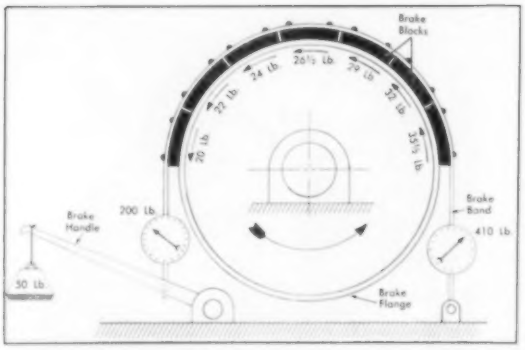


TWO BIGGEST PROBLEMS in engine compounds are alignment and cleanliness. Here is way to check alignment. The distances C and C' should be equal. The straightedge should lie flat along both sprockets. Fig. 16.

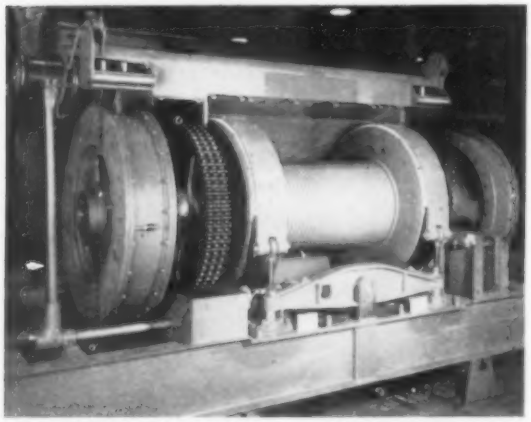
KEEP PROPER TENSION on chains and they will last longer. If it has the proper tension, the loaded side of the chain will be tight and almost straight when running. Fig. 17.



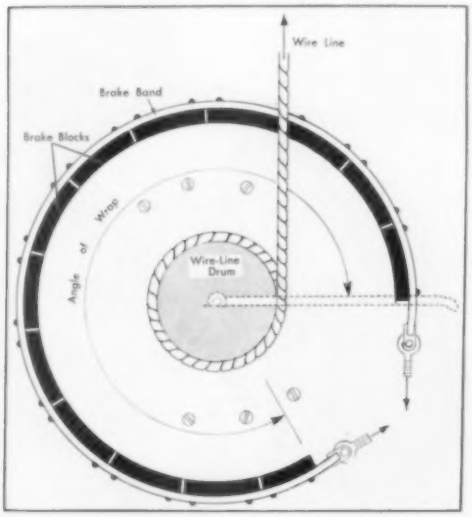
A GOOD WAY to get proper chain tension. Turn one sprocket to tighten the lower strand. Then, measure the sag in upper strand. The sag midstrand should be about 2% of the length of the tangent to the sprockets. Fig. 18.



AS BRAKE DRUM TURNS, each of the brake blocks drags on it. The drag of each of these blocks adds to the tension in the brake band. For this reason, the dead end of the band has more tension than the live end. Fig. 19.



THE TWO BRAKE BANDS in draw-works drum brakes are connected by equalizer bars on the dead end. Keep the bands adjusted. If one is out of adjustment, it will act through the equalizer and cause the brake lever to kick. Fig. 20.



TWO IMPORTANT FACTORS in comparing brakes are the angle of wrap and the ratio of the flange diameter to the drum diameter. The imaginary lever arm at right shows where the forces on the flange and the line pull on the drum act. Fig. 21.

Chains

If the chain can be slipped over the ends of the teeth, a new chain is usually necessary.

When you inspect, look for these things also:

1. Wear of inner surface of side bars and sides of sprocket teeth. **Cause:** Sprockets or shafts are misaligned. **Cure:** Check both angular and offset alignment. Be sure keys are secure and bearings are rigid.

2. Broken or cracked parts. **Cause:** Fatigue failure. **Cure:** Replace with new chain if necessary. Otherwise, replace with complete assemblies of connecting links or roller links. Don't replace with individual parts such as rollers, pins, or bushings as this destroys press fit.

3. Teeth-gouge marks on chain rollers. **Cause:** Chain has enough slack to top sprocket teeth. **Cure:** Replace with new chain if necessary. Otherwise, shorten the chain by one or two links.

4. Tight joints. **Cause:** Collection of dirt and rust. **Cure:** Clean thoroughly and reoil. If this doesn't loosen them, replace with new roller and pin link.

5. Hook-shaped sprocket teeth. **Cause:** Normal wear. **Cure:** Replace if possible. Otherwise, reverse sprocket on its shaft.

6. Different pin-bush clearance in different parts of the chain. **Cause:** Oil is not being distributed evenly over the chain. **Cure:** Check lubrication system to be sure oil lines are open, oil levels are being maintained.

7. Loose pins. **Cause:** Overloading beyond the elastic limit of chain. **Cure:** Replace with new connecting link. If left, loose pin will bring on failure of mating side bars.

Drum brakes

. . . how they work

. . . how to make them last

. . . how to check for wear

A SIMPLIFIED sketch to show how self-energizing band brakes work is shown in Fig. 19. Though each manufacturer makes his different in detail, all drum brakes on modern rigs are of this general type.

This type brake is called self-energizing because only a small amount of force on the brake lever will apply a lot of pressure on the brake rim. Thus, a 150-lb. driller is able to stop a block load weighing hundreds of thousands of pounds. Almost all main drums have two brake flanges as shown in Fig. 20. The two brake bands are connected by an equalizer bar which divides the braking force equally between the two bands.

Band brakes work well in only one direction. So, of course, draw works-drum brakes must be set so they work best when stopping the falling blocks. When the blocks are going up empty, it's possible to push hard enough on the brake lever to stop the blocks almost instantaneously. But to stop them this quickly can cause the drilling line to backlash on the drum.

How to compare brakes . . . There are two things we want brakes to do: First, hold the load; second, last a long time. In comparing the load-holding ability of different brakes, these are the things to consider: ratio of brake-flange diameter to drum diameter; angle of contact between the lining and flange (wrap); mechan-

ical advantage of the lever linkage; and coefficient of friction of the lining.

To see why diameters of flange and drum are important look at Fig. 21. Think of the leverage involved The farther out the flange is from center, the more leverage it can develop and the more line pull it can hold for the same weight on the brake handle. Likewise, the smaller the drum, the less leverage it will have and the easier it will be to hold. Remember, though, that a big-diameter flange doesn't mean anything in itself; it's the ratio between it and the drum diameter. Most draw works have about a 2:1 ratio between flange and drum diameter.

Modern drum brakes usually have more than three-fourths of the possible 360° wrap with brake lining. And, as a rule, we want as much angle of contact between lining and flange as possible. The greater the angle, the greater will be the braking force. For instance, a brake with 330° wrap will hold almost half again more line pull than will a brake with only 270°, all other things being equal.

It's a simple matter to get great mechanical advantage in the brake-lever linkage simply by juggling center distances. It would be possible to make a linkage so that 5 lb. would hold what it takes 50 lb. on the lever to hold on the best rigs. The trouble is that for each gain in mechanical advantage, we have to give up some of the travel in the brake band. The less travel in the band, the closer the clearances have to be. Small clearances cause dragging of lining on the flange, difficulty in adjusting the brakes, and fast wear of both linings and flanges. As a result, manufacturers have to compromise to get enough mechanical advantage without giving up too much band travel.

How about lining width? . . . Notice that we have said nothing about face width of the brake lining. This is because width of lining has very little to do with how much the brake will hold. However, face width is extremely important in getting long life from the lining. Generally, the narrower the linings, the higher will be the pressure between them and the flanges; the higher this pressure, the faster both will wear.

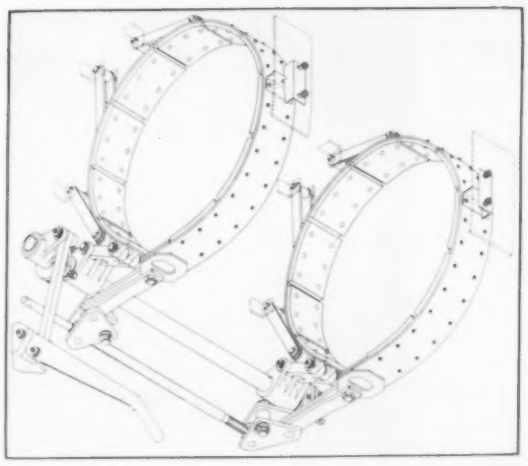
Keep bands round . . . On most rigs, the thing that causes more undue wear of brake flanges and linings than any other is out-of-round or kinked brake bands. Besides causing wear, the distorted bands are likely to fail from fatigue and they cause the brake lever to "kick."

The usual cause for out-of-round or kinked bands is jerking them out of the draw works with the catline. When you are taking out the bands to replace the linings, do not use the catline; follow the manufacturer's recommendations. While the bands are out, check them for roundness. This can be done by drawing a circle (of the same diameter as the band) on the floor and laying the band around it. If the bands are not tangent the full circumference, have them rerolled or replace them.

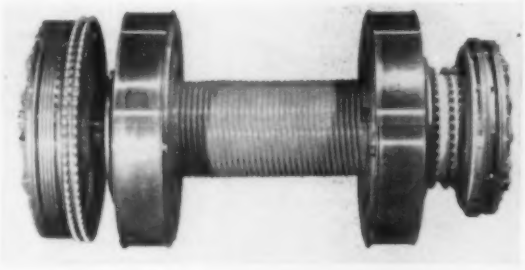
Why blocks pull off bands . . . Sometimes in service, the brake blocks pull off the bands by tearing out the bolt holes. This may be caused by defective lining. But more often it is caused by: (1) overloading the rig; (2) too few bolts holding the blocks; or (3) inside of the brake band being unclean.

These same three factors can cause the brass bolts themselves to shear off.

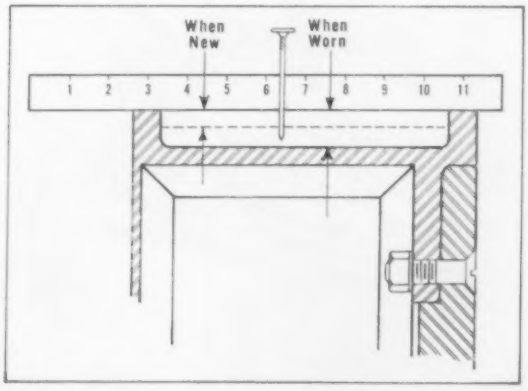
When the inside of the brake band is clean, the friction between band and block will hold them together.



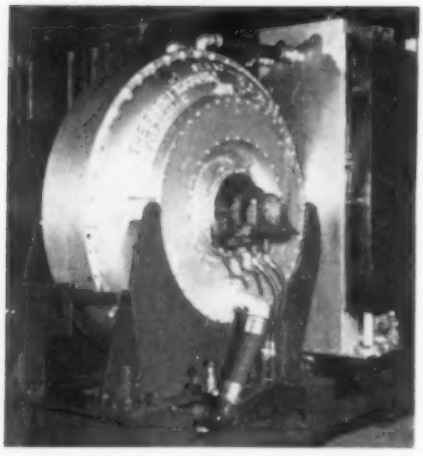
SCHEMATIC OF BRAKE SYSTEM. Mechanical advantage of the hand-lever system is easy to increase, but every increase here means giving up some of the travel in the brake bands. The less the travel, the closer clearances must be. Fig. 22.



BRAKE FLANGES on draw-works drum. As the rims on these flanges wear, they are able to absorb less heat. When wear exceeds the amount recommended by the manufacturer, the rim should be replaced. Fig. 23.



A GOOD WAY to check the brake rim for wear. Lay a straightedge across the flanges and use a nail to measure the depth to the bottom of the deepest groove. Measure several places around the rim. Fig. 24.



Drum brakes

THE HYDROMATIC is the most common auxiliary brake. Auxiliary brakes absorb most of the power generated by lowering big loads into the hole. This should make it possible to lower the pipe within 10 ft. of the rotary without using the band brakes. Fig. 25.

When that surface is dirty, there isn't enough friction and the load will be thrown onto the bolts and bolt holes. For that reason the inside of brake bands should never be painted—paints have a low coefficient of friction. Don't allow grease, oil, or any other foreign matter to get onto the backs of the blocks; clean all rust, dirt, and grease off the inside of the bands before putting on the brake blocks.

Maintain the linkage, adjustment . . . The complete brake mechanism should be checked once each well (oftener on deep, lengthy wells) for loose clamping bolts, missing cotter pins, and the like. Moreover, the brake mechanism should be lubricated regularly.

When the lever is released on a properly adjusted brake, the lining will be clear of the flange completely around its circumference. There will be no wear-and-heat-producing drag. If band rollers and springs are not properly maintained, the dead end of the band will drag on the flange. Also, in any self-energizing brake, the dead end of the band will ordinarily contact the flange first. And because of the self-energizing design, the dead end puts more pressure against the drum. As a result, it will ordinarily wear faster than the remainder of the lining.

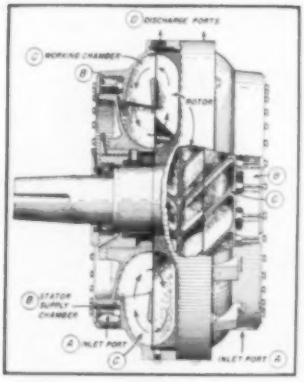
Cooling, key to long life . . . Heat generated in the brakes must be thrown off quickly or it will cause poor brake action and shorten the life of both flanges and linings. Getting rid of heat quickly means circulating water through the brake at all times during a round trip and when rate of feed-off is high.

Rig brakes generate their greatest amount of heat when pipe is lowered into the hole during a trip. At these times, the engines are idling, and the compound shafts are turning very slowly. As a result, cooling-water pumps driven off the compound put out the least water at the time when most water is needed. For that reason, a separately driven water pump is a necessity if brakes are going to last as long as they should.

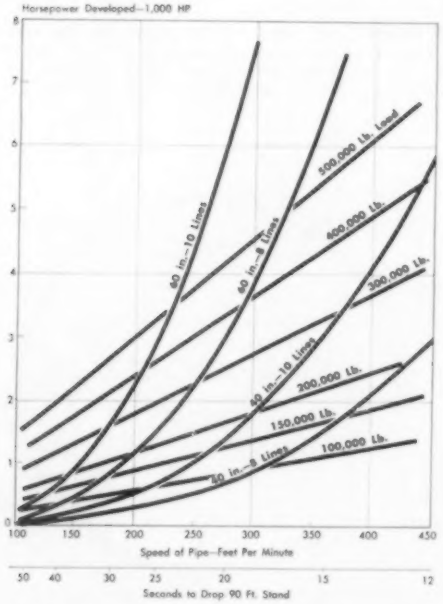
Be sure that the water piping is arranged so that the flange water jackets will not be "starved" when the auxiliary brake is operating. Make the discharge line of the 2-in. pipe and avoid running it higher than the drum shaft. Keep length of the discharge line short so back pressure on the system will be low. Put the end of the line where you can see whether or not water is coming out.

In many areas the cooling-water supply will cause scale in the flange water jackets. This scale acts as an insulator and keeps the water from carrying off brake heat fast enough. Moreover, the scale can cause the water to channel through the jacket. The result is fast, uneven wear. If your area has hard water, check the water jackets regularly; if scale is building up, flush it out with a solvent.

How to check for wear . . . The farther a brake rim wears down, the less heat it is able to absorb. Since it can't absorb heat well, it wears even faster. And the



THE HYDROMATIC is built somewhat like a centrifugal pump. However, instead of pumping the water out, the brake uses the water as a cushion. Water pressure in the brake has nothing to do with its effectiveness. Fig. 26.

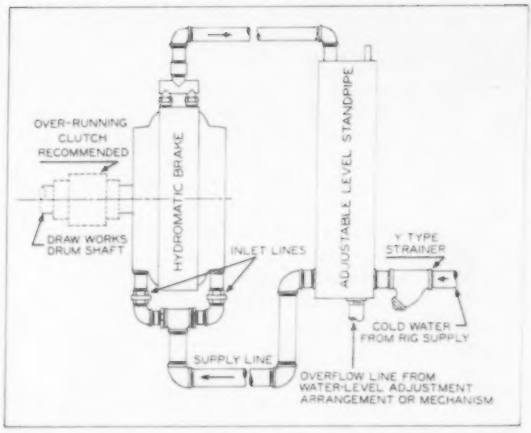


BRAKING CAPACITY of the Hydromatic goes up rapidly with the speed of rotation. For that reason, the braking power of any size model is greater with 10 lines strung than with 8 lines—fast-line speed (and brake speed) is greater with 10 lines. Fig. 27.

higher temperature causes the brake lever to rise while pipe is being run in. So when rim wear exceeds the amount the manufacturer recommends, the rim should be replaced.

There are two ways to check brake-rim wear; one is shown in Fig. 24. Lay a straightedge across the flange and measure the distance from it to the bottom of the deepest groove. A sharp-pointed metal object such as a nail can be used to make this measure. Measure in several places around the rim. Compare wear-down shown by this method with the amount recommended by the rig manufacturer. If it is more than recommended, replace the flanges when possible.

The "worn circumference" of the brake rim can be measured by using a piece of string wrapped around the flange so that it lies in the part most deeply worn. Be sure that the string is the same distance from the edge all around the flange. Take a firm pull on the string and mark where it meets. Take the string off the flange and measure it, using the same pull on it as before. The measured length of the string will be the worn circumference.



WATER-SUPPLY SYSTEM for the Hydromatic brake. Braking effect is greatest when the brake is completely full of water. To get partial brake effect, the driller can regulate the water level to any height in the housing. Fig. 28.

Auxiliary brake . . . how it works, how to keep it working

DRAW-WORKS HAND BRAKES aren't big enough by themselves to handle all the loads of deep-well drilling; they aren't intended to be. It is far simpler and cheaper to use an auxiliary brake to absorb the power generated by the falling pipe when going in the hole.

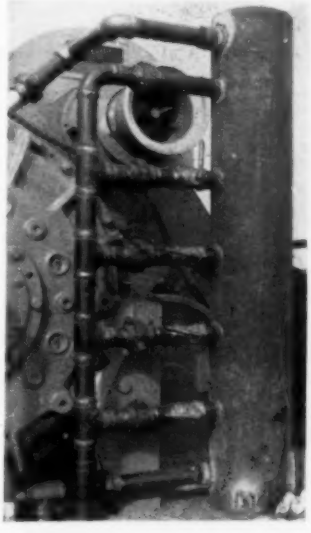
Fig. 25 shows the most common auxiliary brake, the Hydromatic; it gets its braking effect from fluid friction. As Fig. 26 shows, the Hydromatic is built somewhat like a centrifugal pump. However, it is purposely designed so that the water absorbs the pump energy instead of being pumped out.

Higher speed, more braking . . . Total braking capacity of the Hydromatic goes up roughly as the fifth power of the rotor diameter and as the third power of the speed of rotation. As an example of this, look at Fig. 27, which shows a Hydromatic has a much greater load capacity with 10 lines strung than with 8. Chief reason for this fact is that fast-line speed (and brake speed) is higher with 10 lines strung.

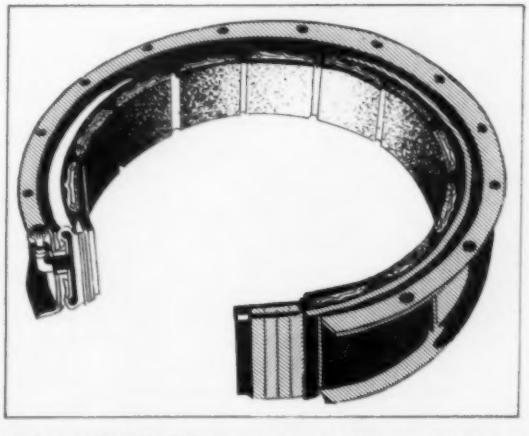
The Hydromatic's big jump in braking capacity with each small increase in speed makes it self-regulating to a certain extent. That is, if you add more weight, the blocks will tend to fall faster; and the brake will respond with greater braking effect. Thus the driller can add several stands of pipe before he has to raise the water level in the brake to get more resistance.

Note also in Fig. 27 that the capacity of the 60-in. brake is more than three times that of the 40-in.; only essential difference in the two sizes is the rotor diameter. Double-rotor models have a capacity almost twice that of single-rotor models of the same diameter.

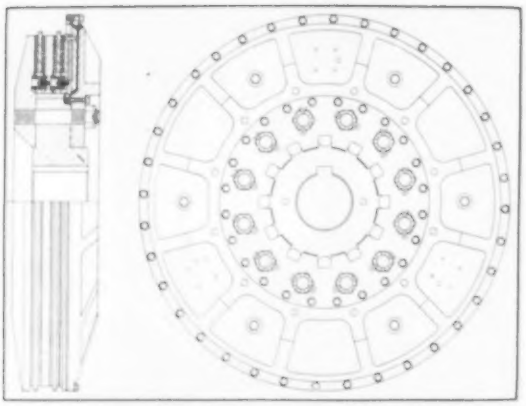
Control effect with water level . . . The Hydromatic gives its greatest braking effect when completely full



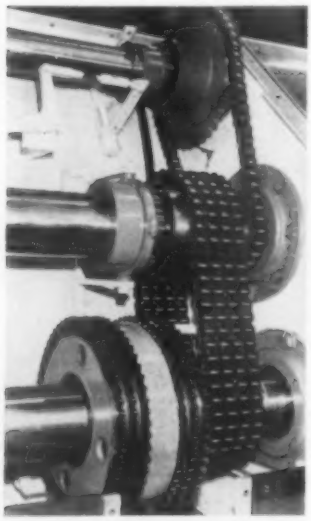
A COMMONLY used system for regulating the water level in the auxiliary brake. Regardless of the water level, be sure that the brake is getting a good supply of cool water. If is isn't, the brake will heat and will lose part of its effectiveness. Fig. 29.



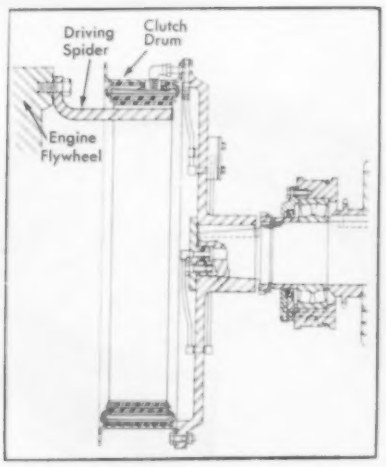
DIRECT AIR-OPERATED drum-type clutch. It is simple and easily understood by rig personnel. Key to long life of this and any other air-operated clutch is getting the air into and out of it quickly. Fig. 30.



DIRECT AIR-OPERATED disk clutch. This clutch requires less space than the drum-type and can usually be put back in good repair by replacing only a few inexpensive parts. Fig. 31.



GEAR OR SPLINE-TYPE CLUTCH. These should never be operated when there is much relative movement between shafts. If they are so shifted, there will be "burring" as well as bad shock loading on all parts. Fig. 32.



A DRUM-TYPE AIR CLUTCH used as an engine clutch. When lining up the clutch to the engine flywheel don't depend on feeler gages. Use a dial indicator mounted on the clutch driving spider and indicate on the clutch drum. Fig. 33.

Auxiliary brakes

of water. Of course the driller needs this full effect only when nearing the end of a trip to the depth capacity of the rig. At other times he needs only a part of the brake's capacity. To get the partial brake effect the driller can vary the water level in the brake housing.

There are many systems for regulating water level; Fig. 28 shows the general system and Fig. 29 shows a commonly used arrangement.

Water is for cooling, too . . . Besides regulating the resistance of the brake, the water has another purpose—it must carry away all the heat generated by the falling load. For that reason the brake must have cooling water circulating through it whenever it is in use. If to little water passes through, the brake will overheat, steam will form, and the brake will lose capacity until cooled. Also, excess heat can make it hard to control level of the water in the housing.

So that cooling water can circulate freely, be sure that are no restrictions from small piping, long runs, or unnecessary fittings. Inlet lines should be at least 2-in. diameter. And, on 46 and 60-in. brakes, the inlet lines should be 3-in. diameter.

On rigs where the water from the brake is run out into the pit, don't try to save water by pinching down on the supply going in; this will only lead to overheating and loss of brake effectiveness.

Keep pressure down . . . Hydromatic brakes need very little maintenance if operated properly and lubricated regularly. However, some drillers bring on trouble by carrying too much water pressure in the brake housing. It's a fact that 10 psi. in the housing gives as much braking effect as 60 psi. The packing will last much longer at the lower pressure. So keep the pressure at 10 psi. or less.

Replace leaky water seals immediately to make sure that water doesn't get into the bearings.

Check the Hydromatic at regular intervals to see that it is getting enough lubrication. Usually the bearings should be lubricated every day or before each round trip. Use a small amount of No. 2 calcium-base grease. Don't use too much; it can cause the bearing to heat.

If the brake is mounted with a torque arm, check it after each well to make sure that the front torque-rod spring is compressed enough to support the weight of the brake.

Direct connected . . . On most large rigs, auxiliary brakes are cradle-mounted on the draw-works-frame beams, directly connected to the end of the draw-works-drum shaft. Thus, the brake's rotor turns one revolution for each revolution of the drum shaft. Sizing the auxiliary brake for this kind of connection is usually simple. The manufacturer has charts like that in Fig. 33 which takes into account all important factors and show the right brake for a particular job.

There are some things which the rig owner must know before selecting a brake. These are draw-works-drum diameter, number of lines strung up, greatest weight the rig will ever handle, the slowest speed at which it will ever be necessary to lower the pipe.

Greatest weight to be handled will include not only hook load but also weight of traveling blocks, hook, elevators, and links.

With speed increasers . . . Many modern draw works must be built for easy portability. On these the width

of the draw works must be within highway limits. For that reason the frame beams run perpendicular to the drum shaft, and the auxiliary brake cannot be set at the end of the draw works. It must be in front or behind the chain driven off the drum shaft.

Each brake size has a top speed above which it shouldn't be run. For instance, a 15-in. Hydromatic shouldn't be turned up faster than 2,500 r.p.m. and a 22-in. no faster than 1,000 r.p.m. For that reason, there's a limit on the speed ratios of the drives. Most have a ratio between 3:1 and 4½:1; and 5:1 is the absolute maximum.

Overrunning, jaw clutches . . . Many direct-connected Hydromatic brakes have an overrunning clutch between them and the drum shaft. Since an overrunning clutch operates in one direction only, the brake doesn't turn when the empty blocks are hauled up the derrick. Thus the engines have no more load than the blocks.

Actually the resistance of the brake is small when run in reverse. For that reason many drillers are satisfied to "drag" the brake when pulling up the blocks. In such a case a simple jaw clutch is good enough connection between draw-works drum and brake.

Some prefer an arrangement that allows them to dump all water out of the brake. Dumping the water kills the brake's resistance completely. This arrangement is common on "high speed" brake connections.

Clutches . . . where and how they are used, and how to keep them trouble-free

MOST COMMONLY USED clutch on the modern power rig is the direct air-operated drum-type clutch like that in Fig. 30. It is used as an engine-to-compound clutch, master clutch, rotary-drive clutch, high and low draw-works drum clutch, pump-drive clutch, catheadshaft clutch, and elsewhere. It has the advantage of being simple and easily understood.

The direct air-operated disk-type clutch shown in Fig. 31 is used in as many places as the drum type. The disk-type takes less space than the drum type and can be put back in good repair usually with replacement of only a few inexpensive parts. In both types, air pressure in the rubber elements expands them to engage the clutch.

There are also three types of positive clutches used on rigs. In the selective transmissions, two-speed pump drives and the like, a splined or gear-type clutch like that in Fig. 32 is often used. An over-running clutch is sometimes used to connect the auxiliary brake to the draw-works drum shaft. The third type, the jaw clutch, cannot be used on power rigs where they must engage a turning shaft; they throw too big a shock on the bearings, shafts, and chains. However, the jaw clutch is used at some places in the engine compound and to connect the auxiliary brake. Since electric drives have high power at zero speed, some new electric rigs use jaw clutches in many of the drives.

Get air in and out of clutches fast . . . The key to long life in an air clutch is getting air into and out of it as fast as possible. If air pressure is too slow in building up, the clutch will slip too much before it is engaged fully. If air pressure is too slow in releasing, the clutch will drag before it is completely disengaged. Either of these conditions will result in glazed friction surfaces and overheating. If it continues long enough, the clutch will lose its efficiency, plates will warp, and the rubber elements will break down.

To be sure air gets into and out of the clutch quickly, keep the regulating valve and release valve in good condition. Be sure that the air compressor is putting out enough volume at high enough pressure—from 100 to 150 psi. according to the rig. A big air tank helps too.

If the air clutch fails to carry its normal load, it's a good idea to stop the shafts and put a pressure gage on the clutch proper. Then, watch the speed with which air pressure builds up and the highest pressure it reaches. If pressure is too slow building up, the regulating valve may be bad or there may be a restriction in the air line. If pressure doesn't build up high enough, adjust the regulating valve to get full rates pressure. Repair any air leaks in the clutch itself; too low air pressure makes the clutch slip and heat at heavy loads. Too high pressure cuts the flexibility of the drum-type clutch and can lead to damage of other working parts.

If the lining drags on the drum of the drum-type clutch when air pressure is released, check the air lines and the release valve. Be sure they aren't stopped up. If the lines and valves are clean but the clutch still drags, it may mean on some models that the release springs are bad. But, most often, it means that the rubber element has losts its resiliency and needs replacing. Usual reason for loss of resiliency is overheating from prolonged slipping.

The same can apply to the disk-type air clutch. However, the trouble may be in the release springs. Whenever the clutch doesn't release promptly when disengaged, check to see that there is no air pressure remaining in the clutch. If the air is all getting out, replace the release springs.

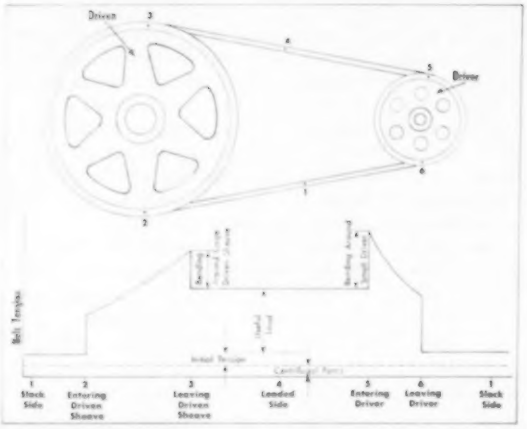
Warped plates and dirt on teeth may also cause trouble.

No adjustment on air clutches . . . Biggest advantage of any air clutch is that it doesn't need adjusting, ever. Moreover, the drum-type air clutch (Fig. 30) has few working parts. Thus, if properly operated, it will last a long time with very little care.

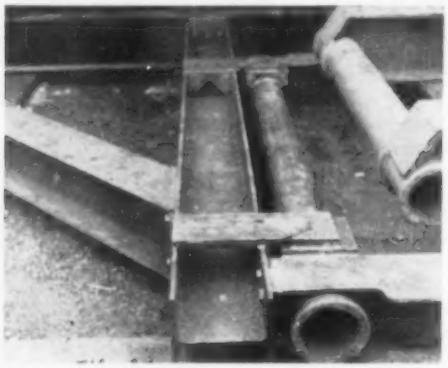
The drum-type air clutch has little tolerance for misalignment. And the higher the pressure in the clutch, the less misalignment it will stand. So, be sure that the clutches are aligned with the clutch drums when they are first put into operation and after every rig move.

Don't use feeler gages to align the clutches. Use a dial indicator mounted on the clutch driving spider and indicate on the clutch drum as shown in Fig. 33.

Keep out oil, grease, water, dirt . . . Other than trouble



STRESS DIAGRAM for a typical V-belt drive for a rig mud pump. Tension is less around the large-diameter driven sheave than around the small driver. Bending around either sheave causes more tension than running straight between them. Fig. 34.



USEFUL V-BELT LIFE is lost because the pump isn't set right. Here's a good arrangement for mounting the pump in a cradle tied to the substructure. Center distance can be adjusted by a turnbuckle arrangement. Fig. 35.

ANOTHER CRADLE ARRANGEMENT for proper setting of rig pumps. The center adjustment can keep proper tension in belts so they will not vibrate excessively. Belt guards protect rig workers and belts too. Fig. 36.

Clutches

in the air system, and poor operation of controls, there are two main causes of clutch slipping. First is dirt, oil, grease, or water on the clutch linings. Not only can these things make the clutch slip, but they can cause the lining blocks on drum-type clutches to tear out.

A little oil or grease isn't bad; it can be wiped off or taken off with carbon tetrachloride or a solvent. "Friction dust" can be blown out with air. But, if oil seals go bad and the linings become saturated with oil or grease, both the oil seals and the linings should be replaced. Moreover, be careful when washing down the rig to see that the hose isn't turned on the clutches.

Many air-control valves and rotary air seals need lubrication in the air stream; so do a few older air clutches. But, before you lubricate the air stream, make doubly sure that your rig manufacturer recommends it. On most air clutches, oil in the air stream will attack the rubber element and make it fail quickly. Moreover, remember that almost all disk-type air clutches should not be oiled on the clutch-hub or pressure-plate gear teeth.

The other big cause of clutch slippage is overloading. This can be prevented in most cases by following a few simple rules. Drum clutches and compound clutches should always be engaged with the engines idling. A good driller can time the opening of his engine throttles with clutch engagement so that pickup of the load is smooth. A clearance of several inches is between the pipe elevators and the tool-joint shoulder; this combined with the stretch of the hoisting cable gives the clutch time to fully engage before the full load is on it.

If the clutches are engaged with the engines running at full speed, the clutch will heat and its life will be shortened.

Use the right transmission speed. The high drum clutch may be used as long as the engines can accelerate the load up to the governed speed. This doesn't mean you should "frog" the pipe out of the slips with a high gear when going in the hole.

It's a poor practice to shift under load from the low to the high drum clutch. The result is a lot of friction and heat in the clutch. This is because there is no slack in either the elevators or the hoisting line to cushion shock. Also, the engines will be running at full speed. Not only is this hard on the clutch, it can also cause failure in the drive chains.

Splined clutch, no motion during engaging . . . The gear or spline-type clutch like that in Fig. 32 should never be operated when there is much relative movement betweeen the two shafts. If shifted when there is a lot of movement, there will be severe shock loads on all equipment. In addition, the teeth of splines may "burr" and keep the clutch from operating. For that reason, many rigs have interlocks so that these positive clutches cannot operate until a neutral brake has stopped the two shafts.

On some rigs, however, the drives having gear-type clutches are not changed often enough to justify a neutral brake. On these, don't attempt to "feel" the clutches into mesh until you are sure the power-end shafts are nearly stopped. Many modern rigs have a transmission-shaft-speed indicator at the driller's position to show when clutches can be shifted. If not, you can open the inspection door to the clutch compartment and watch the chain speeds. If the shafts are dead and the clutch won't engage, it may be necessary to start the power shaft turning slowly and feel the clutch in.

V-belts . . . their uses and abuses

FIG. 34 shows the tension in V-belts in a typical mud pump drive. The loads are well within the belt's capacity. But, unfortunately, more V-belts are lost from abuse than from use. Many of the abuses have nothing to do with the belt's actual job. For instance, many belts are lost or destroyed during moves. Others come out of a move too dirty or oil-soaked to use. A lot more don't survive the short time a rig may be stacked between wells.

Look at the drive dimensions . . . In general, you can lengthen the life of belts in a pump drive any time you:

1. Make sheave diameters larger.
2. Cut the amount of power each belt carries.
3. Lengthen the belts.
4. Cut belt speed.

Like any general rule, you can carry this one too far. For instance, if you use too many belts and too large sheaves, the drive will be too big and hard to move. Likewise, if you make the drive too long it will cost more money and it will be hard to guard.

Look again at the second way to lengthen belt life —cut the amount of power each belt carries. Of course this works in reverse, too. If you make the belt carry more power it won't last so long. Some drillers raise the power load on the belts by using fewer belts than the sheaves are meant to carry; they might use 9 belts on a 12-belt sheave. The result is like burning the candle at both ends—it works all right, but burns up twice as fast.

Refer to the latest API specifications for belting; change your drive to match these recommendations if necessary.

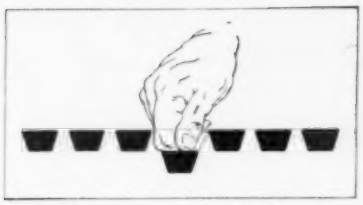
Watch how pump is set . . . On many rigs where the pump is driven off the engine compound, a lot of useful V-belt life is lost because the pump isn't set properly. First, use a pad under the pump that will prevent a lot of settling and shifting after drilling starts. A widely recommended arrangement is mounting the pump in a cradle tied to the substructure like that in Fig. 35. Fig. 36 shows another arrangement where center distance is adjusted by a turnbuckle or screw mechanism called the "pump spacer."

Make sure that the pump shaft is parallel to the shaft on the engine compound. See that the sheaves are in line and running true. If there is eccentricity of the shafts or wobble in the sheaves, the belts will likely vibrate badly. And the vibrations will cause early failure.

Keep the guard on the V-belt drive; this is a safety measure not only for the rig crew but also for the belts as well. At the same time, be certain that the belts don't rub against the guard; see that there is nothing else against which the belts might rub when running.

Get and keep proper tension . . . Do not force V-belts onto the sheaves. Let out the center-distance adjustment until the belts slip on by hand.

Before you tighten the drive, be sure that all the belts are slack on the same side. You don't want the belts to slip when they're running; so you shouldn't expect them to slip when you are tightening the drive. When you tighten the drive with some belts slack on one side and some on the other, the belts can't slip around the sheaves to equalize the slack. As a result,



TO TEST TENSION, mash with thumb on top of each belt in turn midway between the sheaves. The belt should not depress more than one times its thickness for each 4 ft. of center distance. Belts that are too loose will slip, wearing both sheave and belt. Fig. 37.

POOR V-BELT PRACTICE in a mud-pump drive. Not only are belts poorly matched and improperly tensioned, they are striking against the 2 by 6 board which was put there to stop whiplash. Besides, there is no guard to protect the belts. Fig. 38.

MORE POOR BELT PRACTICE. The drive was designed for more belts than are being used. This means each belt carries more load and wears out much sooner. Belts are dirty and will soon slip, causing wear to both belts and sheaves. Fig. 39.

one side will get a bad stretching before the other side gets tight enough.

If you don't follow these precautions, the belts may develop "necked down" sections. Such necking down shows that the belt has been damaged too much to be used again. It should be taken out of the drive and discarded.

Adjust center distance until the belts are snug all the way around when not running. When the belts are running under full load, there should be a slight sag on the slack side.

Keep the proper tension on the belts after drilling has started. New belts stretch when first put to work. As a result, the drive should be checked for tension each day for several days after the new belts are put on.

What is proper belt tension? Use this rule of thumb —mash with your thumb on top of each belt in turn midway between the sheaves as shown in Fig. 37. You should not be able to depress the belt more than one times its thickness for each 4 ft. of belt span. If you can, the drive should be tightened.

Keep sheaves in good conditions . . . When the grooves and ribs on V-belt sheaves are chipped or broken, they can cut the belts or cause them to run over in the groove. If the grooves get too rough, they will abrade the belt. The result of these conditions is short life for the belt. Have bad sheaves regrooved before they ruin the belts completely.

When regrooving, make certain to use the API specifications for belting to get correct top width, angle, and depth.

A common cause of damage to the ribs and grooves is use of a pipe wrench to turn the sheaves by hand. This is a bad practice that isn't completely overcome by using a wooden block under the wrench jaw.

Sometimes a V-belt sheave wears unevenly. The result can be narrow and wide grooves. In this condition, the sheave will put most of the load on a few belts. The higher loads, of course, wear out the belts more quickly. Such a sheave should be regrooved or replaced.

The same wide and narrow grooves can result from improperly done machine work in regrooving. See that your sheaves are regrooved properly by a reliable shop.

Vibrations, if allowed to continue, can become so great that the belts may turn over, jump out of the grooves, or become tangled with each other. In some cases special mechanical devices have been necessary to control vibrations.

Don't allow a belt to continue running when it turns over in the sheave grooves. The damage that results mount quickly.

Keep belts in sets . . . V-belts for slush-pump drives come in matched sets; they should be kept that way. This means that you should not add new belts to old sets. The entire set of old belts should be taken off and replaced with an entire set of new ones.

Any old belts that are still good should be matched with other used belts. Reason for this is that belts continue to stretch as they are used. New belts, being shorter, will take most of the load if used with old belts. So the new belt will wear much faster than it should.

Likewise, belts of one make should not be mixed in a drive with belts of a different make. There may be differences in their dimensions or in the amount of stretch.

Keep the V-belts clean. If they slip because of oil or grease on them, clean both belts and sheaves. Use a clean cloth and a light solvent.

Never use a dressing of any kind on V-belts.

Bearings... How to prevent their failure

ROLLER BEARINGS seldom last as long on drilling rigs as on other machinery. There are two main reasons: first is misalignment; second is poor lubrication.

When bearings are misaligned, they have a scrubbing action besides the normal rolling action. No amount of lubrication will save the bearing if this action is prolonged. So-called "self-aligning" bearings actually have a small capacity for misalignment, but it is small capacity. Only if well aligned will these, or any other bearings, last as long as they should.

We expect, of course, all parts will be aligned as well as possible during rig up. The trouble is keeping this alignment since the substructure settles during drilling. We can't stop settling entirely, but we can set substructure and sills to keep it to a minimum. We can also recheck after drilling is under way and realign parts if necessary.

Oil better than grease . . . Bearings ordinarily last longer if lubricated with a forced-feed oil system than if lubricated with grease. But, since rig parts must be compact and portable, it isn't practical to run oil lines to many remote bearings. Lubrication with grease is the only solution with such bearings.

Grease contains oil suspended by a soap. In the bearing, the moving parts gradually draw out the oil. As this is broken down or lost, it must be replaced by new grease pumped in. The new grease also forces out the old soap residue. However, there's a good chance that some residue and dirt will stay in the bearing and cause rapid wear. Forced-feed oil will flush out such trash.

A greased bearing runs hotter than an oiled one. This is because the bearings run best with only a very thin film of lubricant. With a lot of grease present, there's a churning action that generates heat and breaks down the oil. For that reason many bearings greased every tour or every day would last longer if greased once each week.

While we can't usually change the kind of lubrication on the bearings, we can be sure the type we have does its best job. First, be sure to use the **kind** of oil or grease and use it as **often** as the manufacturer recommends. Second, be sure that the oil or grease is kept clean. This means frequent cleaning of the suction strainer on forced-feed oilers; it also means cleaning grease fittings before putting the gun on them. Of course grease cans and guns must be kept away from dust and dirt. Third, watch oil-pressure gages for signs of stopped-up oil lines.

Other causes of failure . . . Misalignment and poor lubrication cause most bearing failures, but there are a few other causes. One of the most common is use of bad methods to replace bearings. A replacement bearing should have the proper fit. To insure this, the shaft should be measured beforehand.

If possible, the bearing should be pressed on using white lead. However, take care to keep this material out of the bearing. If the bearing has to be heated to put it on the shaft, this should be done in any oil bath. When field conditions make this impossible and a torch is used for heat, the torch should be used with care, keeping it moving so that uneven heat does not overheat a small area on the surface. Result of this will be warping or destruction of the heat treatment, either of which ruins the bearing.

5 Factors that affect Drilling Rate

1. Hydrostatic Pressure
2. Bit Weight and Rotary Speed
3. Mud Properties
4. Hydraulics
5. Economics

BY PRESTON L. MOORE
University of Oklahoma

The author summarizes . . .

Increases in drilling rate as a result of higher bit weight and rotary speed depend on proper use of hydraulic horsepower. This means there must be enough hydraulic horsepower through the bit to remove formation cuttings as they are generated so that no regrinding occurs. At a given bit weight and rotary speed, drilling rate increases with increases in hydraulic horsepower until the point is reached where there is complete cleaning below the bit. After this, increases in hydraulic horsepower have no effect on drilling rate.

The effect of fluid properties does not tie in directly with hydraulics; however, when it is necessary to increase mud weight, viscosity, or solids content, drilling rate decreases. This decrease may be minimized by using more hydraulic horsepower at the bit. This was shown in laboratory tests where there was no regrinding of particles at rates above 3 g.p.m. with water, but regrinding still occurs at 11 g.p.m. with mud. So, to get highest rates of penetration at lowest cost it will be necessary to use the minimum possible mud weight, viscosity, and solids content, and the maximum possible filtration rate.

Obviously, the objective in any drilling operation is to drill a given amount of hole at a minimum cost. Here are the steps to take to get optimum conditions:

1. First, correct mud properties in the direction that gives a maximum drilling rate for a given set of conditions.
2. Select, as shown in this article, an optimum bit weight and rotary speed.
3. Maximize bit horsepower by selecting an optimum circulating rate.
4. Lower surface horsepower to see if there is a drop in drilling rate at lower horsepower. If not, you've been using excess horsepower. If there is a drop, keep bit horsepower at the maximum range.

1. **Hydrostatic pressure.** Drilling rate goes down as hydrostatic pressure (drilling-fluid pressure) goes up. Amount of the reduction in drilling rate depends on the difference in hydrostatic pressure and pore pressure in the rock.

2. **Bit weight and rotary speed.** Field tests can show optimum rotary speed and bit weight. A method given in this paper is a basis for starting.

3. **Mud properties.** Drilling rate goes down as drilling-fluid weight, viscosity, and solids content go up. Use of oil emulsion and high filtration loss raises drilling rate.

4. **Hydraulics.** Hydraulics programs should be based on the optimum circulating rates rather than annular velocities.

5. **Economics.** Optimum drilling rate does not depend on physical factors only. There are economic factors which must be considered to get minimum cost per foot of hole drilled.

A feature of the Annual Drilling Number of The OIL AND GAS JOURNAL

How drilling rate is affected by 1.

Hydrostatic Pressure

THERE ARE three pressures that may affect rock failure when drilling. These are:

1. The overburden (or terrastatic) pressure.
2. The hydrostatic pressure of the drilling fluid.
3. The pore fluid pressure of the rock.

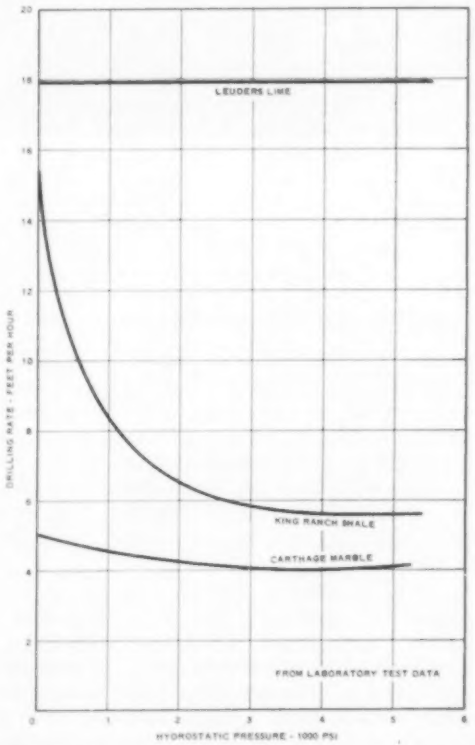
Overburden pressure and pore pressure are things over which we have no control, but they are important because of their relationship with hydrostatic pressure which we can control.

Fig. 1 shows the effect of hydrostatic pressure on three different types of rock in the laboratory. The samples of Leuders limestone and Carthage marble were vacuum saturated with water containing 50,000 p.p.m. salt; no attempt was made to saturate the impermeable shale. Drilling rate in the shale conformed to that shown by Cunningham[2]; however, the Leuders limestone was unaffected by hydrostatic-pressure increases. The effect of hydrostatic pressure on the Carthage marble was also very slight. These drilling tests were made using water as the circulating fluid and indicate that the most desirable drilling condition would be where no pressure differential existed across the surface of the rock being fractured.

The work in Fig. 1 shows that if the formation contains a fluid pore pressure consideration must be given to it in predicting drilling rates at various hydrostatic fluid pressures. For example, the constant drilling rate in the samples of Leuders limestone is a clear indication that confining pressure has no effect on drilling rate if the pore fluid pressure within the rock is equal to the confining pressure.

In Fig. 1 drilling rate had a slight decrease with confining pressure in the Carthage marble. This apparently was caused by the low permeability of the marble which prevented a complete equalization of external and internal pressure as the rock was being fractured. As a result, there was some compaction which caused drilling rate to go down.

With 1¼-in. microbits . . . Because pore pressure apparently does contribute to rock failure, laboratory tests with 1¼-in. microbits were made using a fluid pore pressure in the rock sample. Fig. 2 shows drilling rate in Indiana limestone versus the difference between hydrostatic and pore fluid pressure. Hydro-



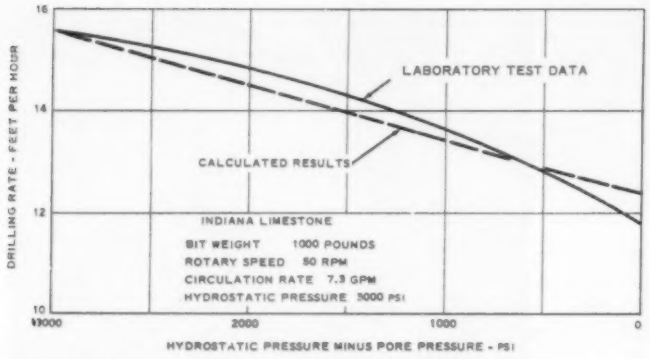
EFFECT of hydrostatic pressure on drilling rate. Fig. 1.

About the author . . .

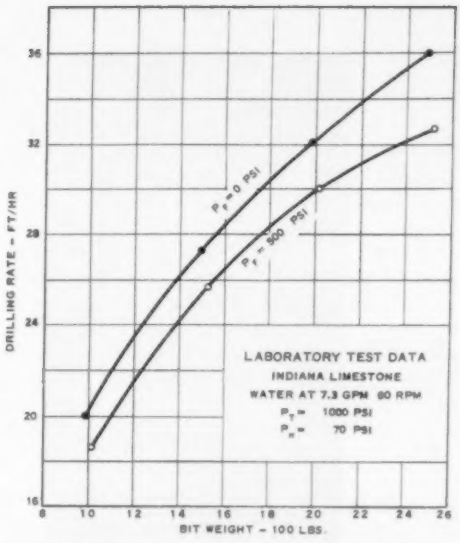
Preston L. Moore is assistant professor of petroleum engineering, University of Oklahoma, and consulting engineer. Before he joined the university in September 1958, he was senior petroleum engineer with Humble Oil & Refining Co., Houston.

Moore received a B.S. degree in petroleum engineering from University of Oklahoma in 1949. Following graduation, he joined Humble and did production work in the Friendswood and Tomball, Tex., districts. In 1952, he moved to Houston with the company's equipment section of the Gulf Coast division. In 1954 he began a year of work in Humble's drilling-research group, working on factors that affect drilling rate. From 1955 until he joined Oklahoma University, he worked on drilling-practice problems in the Houston and New Orleans offices.

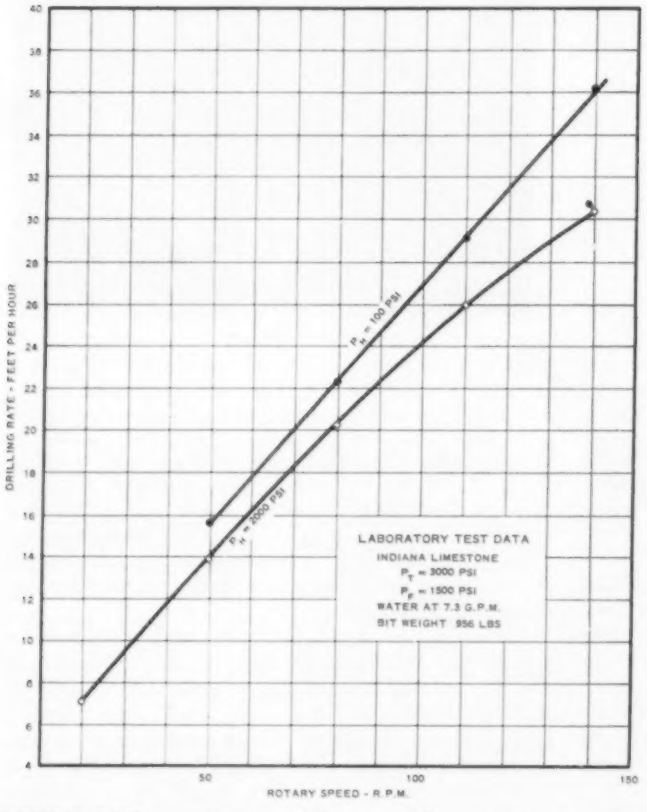
Besides completing Humble's reservoir-engineering school in 1954, Moore attended evening classes at University of Houston from 1955 to 1958. In May 1958 he received his M.S. in petroleum engineering from University of Houston. The material in this article comprises most of his M.S.


DRILLING RATE - FEET PER HOUR
LABORATORY TEST DATA
CALCULATED RESULTS
INDIANA LIMESTONE
BIT WEIGHT 1000 POUNDS
ROTARY SPEED 50 RPM
CIRCULATION RATE 7.3 GPM
HYDROSTATIC PRESSURE 3000 PSI
HYDROSTATIC PRESSURE MINUS PORE PRESSURE - PSI

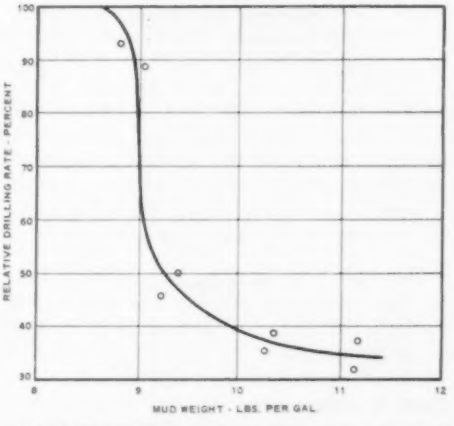
DRILLING RATE vs. hydrostatic pressure, minus pore pressure. Fig. 2.



DRILLING RATE vs. bit weight for two different formation pressures. Fig. 4.



DRILLING RATE vs. rotary speed for two different hydrostatic pressures. Fig. 3.



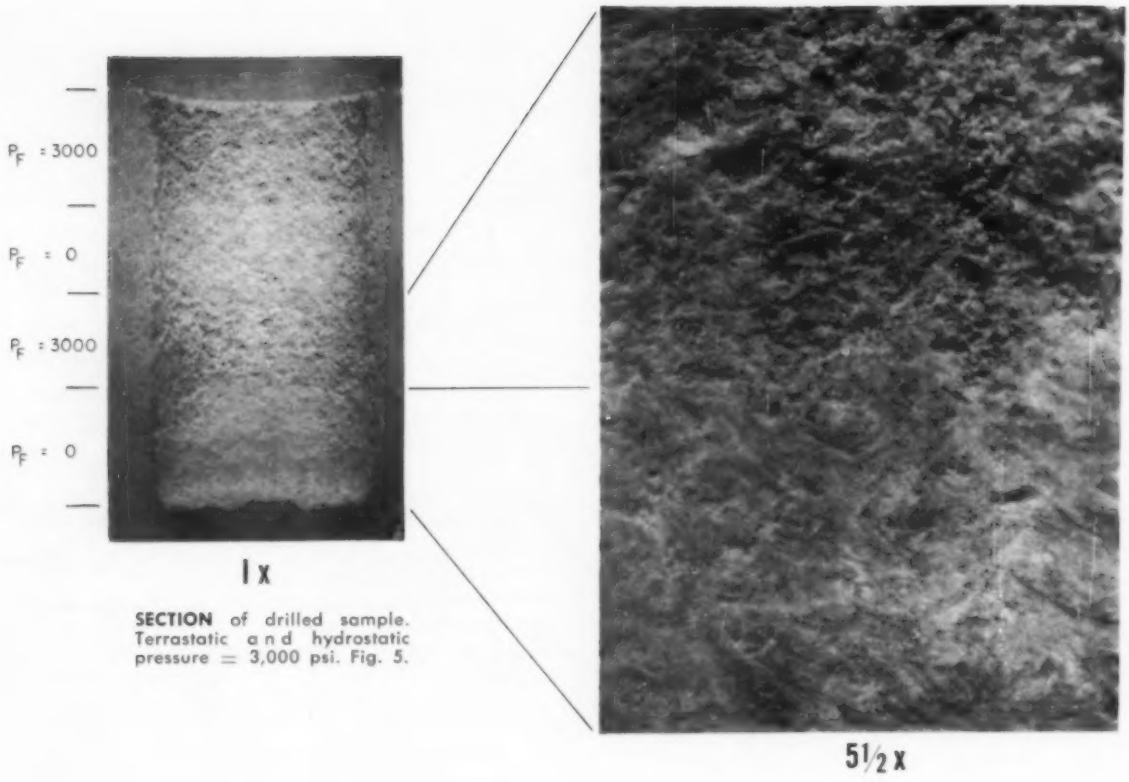
FIELD TEST DATA showing effect of mud weight on drilling rate. Fig. 6.

"... It is clear that compression does take place in a rock. The amount of this compression of course depends on the amount of the pressure differential from the bore hole into the formation. Therefore, the effect hydrostatic pressure has on drilling rate will depend on: (1) pore volume of the rock ... (2) permeability of the rock ... (3) weight of the drilling fluid ... and (4) fluid pressure within the pores ..."

static pressure was maintained at 3,000 psi. and pore pressure varied between zero and 3,000 psi. Bit weight was kept at 1,000 lb. and rotary speed was 50 r.p.m.

Fig. 3 shows drilling rate as a function of rotary speed at a differential between hydrostatic and pore pressure of 250 psi. and 500 psi.; this is the range generally used in drilling. Note the drilling rate is about 20% greater at the lower pressure differential regardless of rotary speed. Bit weight in this case was constant at 756 lb.

Fig. 4 shows drilling rate as a function of bit weight at formation fluid pressures of zero and 500 psi. Of interest here is the fact that hydrostatic pressure was only 70 psi. in both cases and that drilling rates were lower at the pore pressure of 500 psi. than at zero pore pressure. This indicates that a pressure differential into the well bore will also slow down drilling rates as compared to the condition where no differential exists. In this case, a pore pressure in excess of the hydrostatic pressure increased the strength



SECTION of drilled sample. Terrastatic and hydrostatic pressure = 3,000 psi. Fig. 5.

of the rock. So, drilling rate slowed down. This is possible since pore pressure was maintained by pumping fluid into the rock through an O-ring sealed opening in the bottom.

There is compression . . . Fig. 5 shows the effect that a hydrostatic pressure of 3,000 psi. had on a rock sample with a zero and 3,000-psi. pore pressure. When pore pressure was 3,000 psi. or when there was no pressure differential across the rock grains, there is practically no compaction. Yet, when the pore pressure was zero or when a pressure differential of 3,000 psi. was applied, the rock grains were clearly compressed together.

From this picture, it is clear that compression does take place in a rock. The amount of this compression of course depends on the amount of the pressure differential from the bore hole into the formation. Therefore, the effect hydrostatic pressure has on drilling rate will depend on: (1) pore volume of the rock—this limits the amount of compaction that can occur; (2) permeability of the rock—this is a measure of the time necessary to equalize the pressure across the rock surface if there is an initial differential; (3) weight of the drilling fluid—this determines the hydrostatic pressure; and (4) fluid pressure within the pores, which determines the effective pressure.

An example of mud weight on drilling rate in a field test in West Texas is shown in Fig. 6. This curve is similar to the laboratory test curve for shale shown in Fig. 1. It indicates that, in this case, a small increase in hydrostatic pressure greatly decreased drilling rate.

It would not be safe to say, however, that this decrease in drilling rate was a function of hydrostatic pressure alone. As weight of drilling mud goes up, other properties such as viscosity and solids content also change. This may also partially account for any change in drilling rate.

What can be done about the effect of hydrostatic pressure on drilling rate? First, let us refer back to Fig. 3. In this example, using water as the drilling fluid, the drilling rate was 20% lower using a hydrostatic pressure of 500 psi. above formation pore pressure than it was with a pressure differential of 250 psi. This shows that mud weights should be a minimum at all times. To find the absolute minimum weights, investigate all known formation-pressure gradients before drilling the well. Frequently, with good drilling-fluid properties and careful handling of drill pipe, hydrostatic pressure may need to be no more than 200 psi. higher than formation pressure.

Fig. 5 shows an example of the effect of hydrostatic pressure (mud weight) on drilling rate in two South Mississippi wells. With a mud weight of 9.6 lb. per gallon, one field well was drilled to about 9,000 ft. in 230 rotating hours; an adjoining well was drilled to the same depth with mud weighing 10.4 lb. per gallon in 550 rotating hours. Thus, an 0.8 lb. increase in mud weight increased rotating time by 139%.

The section on effect of mud properties discusses other ways in which an increase in mud weight can slow drilling rate.

2. How drilling rate is affected by

Bit Weight and Rotary Speed

THE OIL INDUSTRY and drilling contractors have long accepted the fact that drilling rates go up with higher bit weight and rotary speed.

Bit weight and rotary speeds have not increased rapidly for the following reasons:

1. Higher bit weight and rotary speed cut bit footage and bit time on bottom. As a result, operators claimed they often were not justified economically.
2. Use of higher bit weights usually caused greater hole deviation.
3. Penetration rate was at times increased only slightly with more bit weight and rotary speed due to the insufficient cleaning of cuttings from bottom.
4. More bit weight and rotary speeds usually accelerated wear on other rig equipment by producing greater vibration.

These were valid reasons in many cases; however, in recent years better bit bearings and design have lengthened bit life under severe conditions. The problem of hole deviation has been at least partially solved by: (1) use of more heavy drill collars on bottom so that the drill pipe stays in tension, (2) the use of drill-collar stabilizers, (3) mathematical work which has shown how many drill collars should be used and how stabilizers should be spaced for a given weight on the bit, and (4) acceptance by most operators of greater hole deviations.

The lack of adequate bottom-hole cleaning was due to insufficient surface pump capacity. And, for higher bit weights and rotary speeds to raise drilling rate, cuttings must be removed from beneath the bit. Currently, many rigs have pumps with enough surface hydraulic horsepower for adequate cleaning. As a result, there is now more experimenting with higher bit weights and rotary speeds.

How does it check in lab? . . . Lab tests were made to check effect of bit weight and rotary speed. Fig. 7 and Fig. 8 show the results. Conditions imposed on the rock sample were essentially the same as found in actual field drilling. Pore pressure is usually about 0.5 psi. per ft. of depth, so these tests compare with a well being drilled at 3,000 ft. Overburden pressure of the formation is usually considered as 1.0 psi. per ft. of depth. The hydrostatic pressure was made 500 psi. in excess of formation fluid pressure.

Notice from Fig. 8 that penetration rate increases linearly with increases in bit weight. Tendency for the curve to begin flattening out is due to inadequate removal of cuttings. Fig. 9, showing circulation rate versus drilling rate in the laboratory, confirms this. The curve in Fig. 9 shows that the drilling rate increases linearly with rate of circulation to 7 g.p.m. at a 1,000-lb. bit weight after which drilling rate does not increase in proportion to rate of circulation. Note that the curve in Fig. 8 starts flattening out at 1,200-lb. bit weight, indicating that the maximum laboratory circulation rate of 7.3 g.p.m. was not adequate to keep the hole completely clean at higher bit weights.

Fig. 10 shows drilling rate versus rotary speed.

Fig. 11 shows effect of bit weights in another series of laboratory tests. These curves also show a direct proportionality between bit weight and drilling rate. In these tests, there was adequate hole cleaning since the weight was below 1,000 lb.

In the field tests . . . Fig. 12 shows the effect of rotary speed on drilling rate, while drilling in the Clearfork limestone at 5,870 ft. in the West Texas area. In this test, drilling rate increased more rapidly with increases in rotary speed than it had in the laboratory experiments. Bit weight was 28,000 lb. and, apparently, the circulation rate kept the hole clear of cuttings.

Figs. 13-14 illustrate the effect of bit weight in the total drilling time of two field wells. By keeping other factors constant and increasing bit weight from 9,000 to 20,000 lb., well A was drilled in 39% less rotating time than well B. If the hydraulic horsepower had also been increased, it is probable that well A would have been drilled in about half as many rotating hours.

Economics

To get the maximum drilling rate from a bit, it would be necessary to have enough effective weight on bottom to bury the bit teeth. Seldom does this occur in the field.

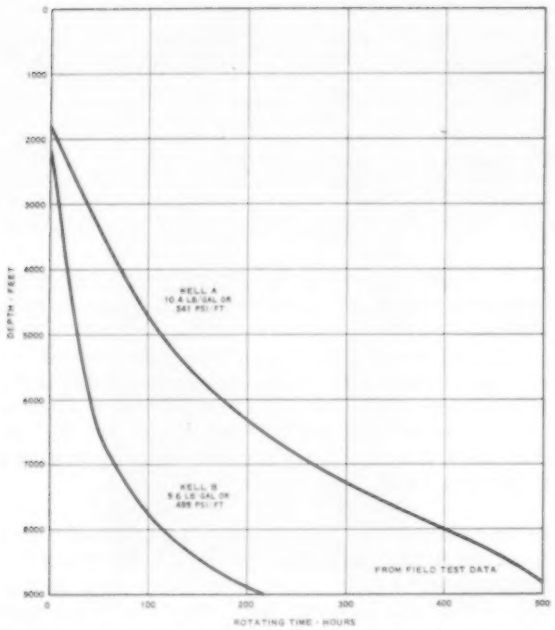
Rotary speeds are usually rather slow. An average speed would probably be about 90 r.p.m. It might be desirable to rotate several hundred r.p.m. New drilling tools such as the turbodrill, which rotate the bit without rotating the entire drill string, can turn at speeds above 600 r.p.m. However, with this tool, wear on bit bearings is so severe that it is not economical to rotate at such high speeds even though drilling rate is higher than in conventional drilling.

For these reasons, there is more to consider than penetration rate in feet per hour. Rotary speed and bit weights must be analyzed considering the economic factors that limit them both.

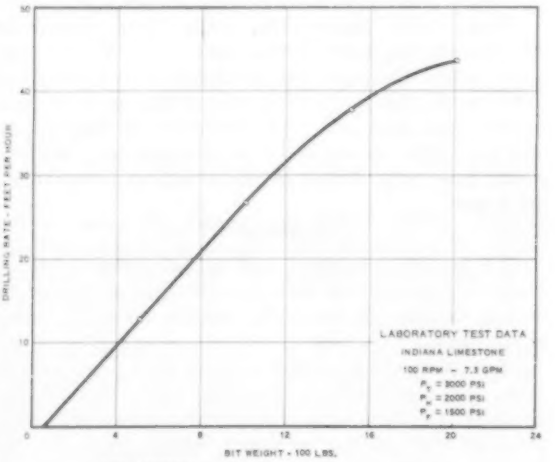
If life of the bit is limited by teeth wear, bit weights and rotary speeds must obviously be at a maximum. However, if bearing failure is the limiting condition, then this must be considered in arriving at an optimum speed and weight.

It has been found that bit life in hours is inversely proportional to the product of rotary speed and bit weight raised to some power as shown in the following equation:

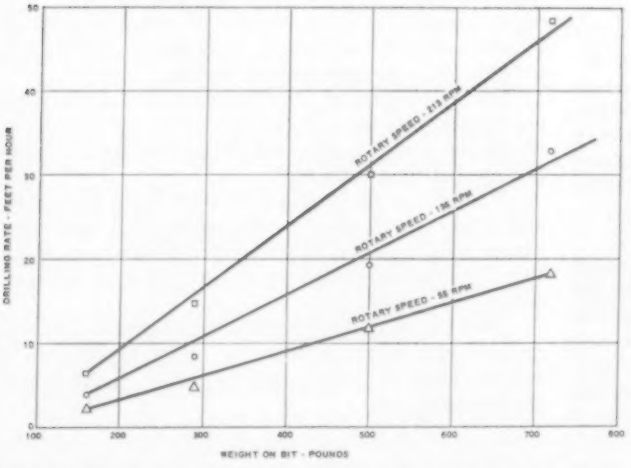
$$L \propto \frac{1}{NW^a} \qquad (1)$$



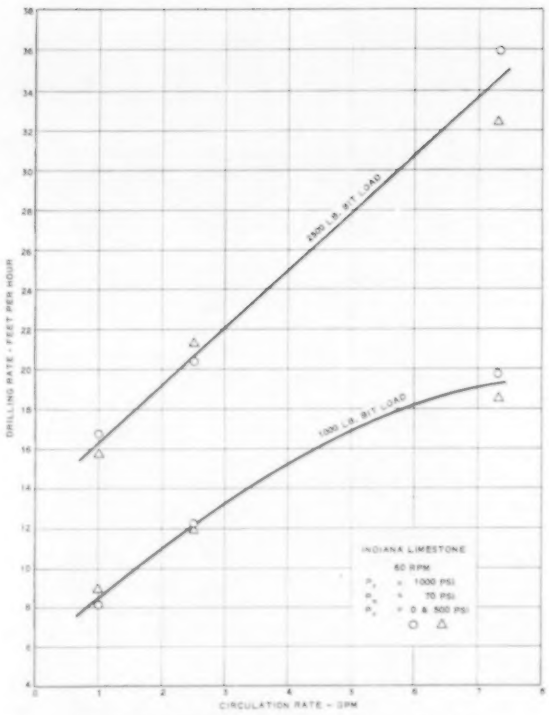
EFFECT of mud weight and hydrostatic pressure on drilling time. Fig. 7.



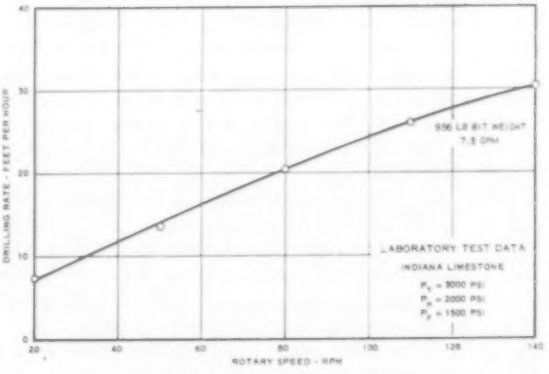
BIT WEIGHT vs. drilling rate. Fig. 8.



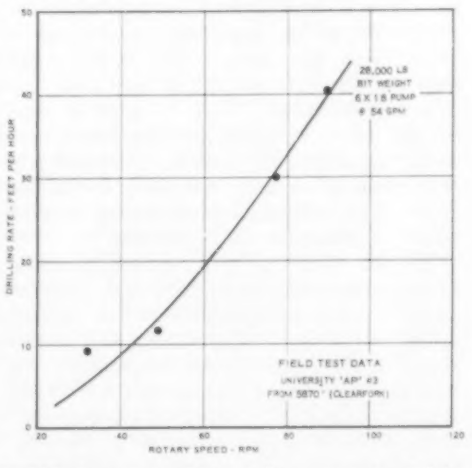
LABORATORY DATA showing relation of drilling rate and weight on bit at constant rate of circulation and rotary speed. Fig. 11.



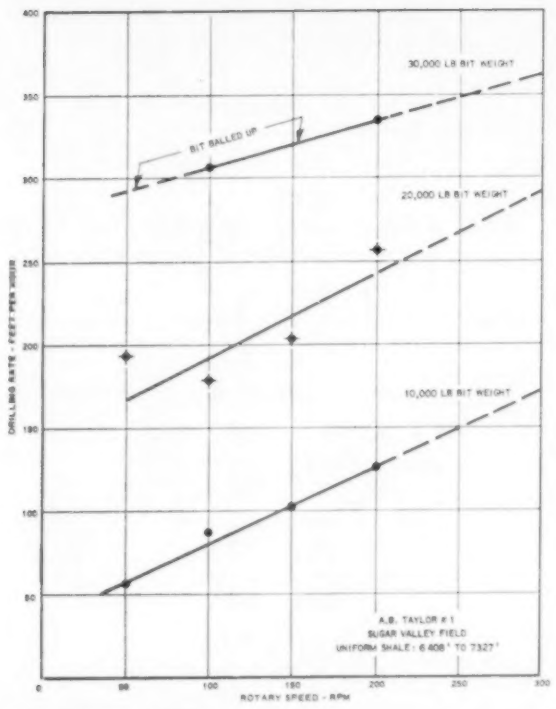
CIRCULATION RATE vs. drilling rate. Fig. 9.



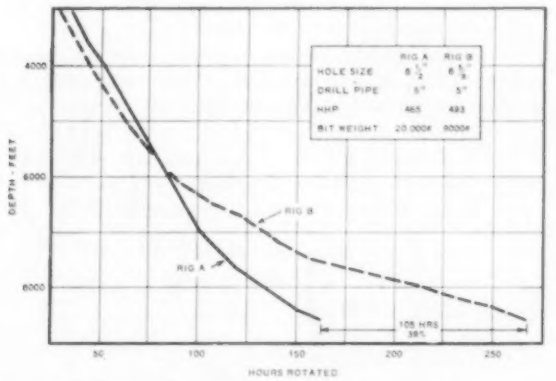
ROTARY SPEED vs. drilling rate. Fig. 10.



EFFECT of rotary speed on drilling rate using 7⅞-in. W7R bits with 3 7/16-in. nozzles. Fig. 12.


30,000 LB BIT WEIGHT
BIT BALLED UP
20,000 LB BIT WEIGHT
10,000 LB BIT WEIGHT
A.B. TAYLOR #1
SUGAR VALLEY FIELD
UNIFORM SHALE: 6408' TO 7327'
DRILLING RATE - FEET PER HOUR
ROTARY SPEED - RPM

ROTARY-SPEED EFFECT on drilling rate using 8⅝-in. two-way drag bits. Fig. 13.



BIT-WEIGHT EFFECT on penetration rate. Fig. 14.

Where:

L = bit life, hours
N = rotary speed, r.p.m.
W = weight on bit, thousands of pounds
a = 2, considered for normal weight muds and used in the following development of an equation for optimum bit weight. Hughes Tool Co. reports the exponent varying from 1.5 for weighted muds, to 3.3 for oils

To find optimum bit weight and rotary speed under a given set of conditions with this equation, we must first consider the factors that add to cost in the drilling operation. The total cost is the sum of (1) the cost of bits, (2) the cost of rotating time, and (3) the cost of round-trip time.

The cost of bits is equal to the depth of the well divided by the footage per bit times the cost of bits. Thus:

$$C_1 = \frac{D}{F} B \qquad (2)$$

Where:

C_1 = the total cost of bits
D = depth of well in feet
F = the footage per bit
B = bit cost in dollars

The total cost of rotating time is the product of the total rotating time multiplied by the rig cost in dollars per hour:

$$C_2 = \frac{D}{R} C_r \qquad (3)$$

Where:

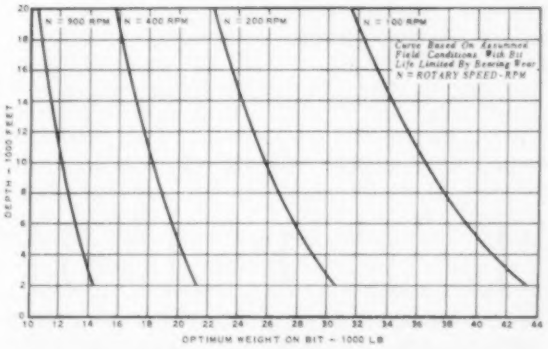
C_2 = the total cost of rotating time
R = the penetration rate in feet per hour
C_r = the rig cost in dollars per hour

Cost of round trip time may be written:

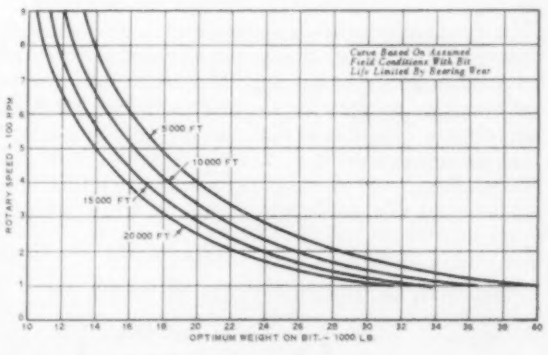
$$C_3 = (A + EM)\, C_r \qquad (4)$$

Where:

C_3 = total cost of round trip time
A = the cost of functions not concerned with well depth such as the handling of drill collars and changing bits
E = the rate at which trip time increases with depth
M = each depth at which the bit is changed in reaching total depth


N = 900 RPM
N = 400 RPM
N = 200 RPM
N = 100 RPM
Curve Based On Assumed Field Conditions With Bit Life Limited By Bearing Wear
N = ROTARY SPEED - RPM
DEPTH - 1000 FEET
OPTIMUM WEIGHT ON BIT - 1000 LB

CALCULATED CURVE for estimating optimum weight on bit. Fig. 15.


Curve Based On Assumed Field Conditions With Bit Life Limited By Bearing Wear
5000 FT
10000 FT
15000 FT
20000 FT
ROTARY SPEED - 100 RPM
OPTIMUM WEIGHT ON BIT - 1000 LB

CALCULATED CURVE for estimating optimum rotary speed. Fig. 16.

To write Equation 4 in general form, we must consider the total number of trips necessary to reach total depth. In simple form this may be written:

Trip No.	Time per trip
1	A + EF
2	A + E2F
3	A + E3F
4	A + (n − 1) EF

Where:

n − 1 = the last trip made prior to drilling with the last bit and

n = total number of trips

Equation 4 may now be written:

$$C_3 = \left((n-1)\,A + n\,\frac{EF}{2}\,(n-1) \right) C_r \qquad (5)$$

All three costs have now been defined and total cost may be written:

$$C_T = C_1 + C_2 + C_3$$

$$C_T = \frac{D}{F}\,B + \frac{DC_r}{R} + \left((n-1)\,A + n\,\frac{EF}{2}\,(n-1) \right) C_r \qquad (6)$$

The total number of trips is the total well depth divided by the footage per bit. In this case, it may be written as

$$n = \frac{D}{F}$$

Therefore, the general equation for total cost is:

$$C_T = \frac{D}{F}\,B + C_r \times \left[\frac{D}{R} + A\left(\frac{D}{F} - 1 \right) + \frac{DE}{2}\left(\frac{D}{F} - 1 \right) \right] \qquad (7)$$

Penetration rate R is proportional to both rotary speed and bit weight. The equation for penetration rate may be written as:

$$R = KWN \qquad (8)$$

Where:

K = constant of proportionality

W = bit weight in thousands of pounds

N = rotary speed in r.p.m.

The footage per bit F is proportional to the bit life in hours times penetration rate, which, with Equation 1, may be written:

$$RL = F = (KWN)\,\frac{K'}{NW^2} = \frac{KK'}{W} \qquad (9)$$

Grouping terms, Equation 7 may be written as:

$$C_T = \frac{DW}{KK'}\left(B + AC_R + \frac{EDC_R}{2} \right) - \left(AC_R + \frac{EDC_R}{2} \right) + \frac{DC_R}{KWN}$$

$$\text{Let } S = B + AC_R + \frac{EDC_R}{2} \qquad (10)$$

$$\text{Let } T = AC_R + \frac{EDC_R}{2} = S - B \qquad (11)$$

$$\text{Then } C_T = S\left(\frac{DW}{KK'} - 1 \right) + B + \frac{DC_R}{KWN} \qquad (12)$$

Minimum cost as a function of bit weight would be:

$$\frac{dC}{dW} = 0 = \frac{DS}{KK'} = \frac{DC_R}{KW^2N} \qquad (13)$$

$$\text{then } \frac{DS}{KK'} = \frac{DC_R}{KW^2N}$$

$$W^2 = \frac{K'C_R}{SN}$$

$$W = \left(\frac{K'C_R}{SN} \right)^{1/2} \qquad (14)$$

Equation 14 then defines optimum bit weight for a given set of drilling conditions. The total cost then at optimum bit weight may be written:

$$C_T = \frac{D}{K}\left(\frac{C_RS}{K'N} \right)^{1/2} - S + B + \frac{D}{K}\left(\frac{C_RS}{K'N} \right)$$

$$C_T = \frac{2D}{K}\left(\frac{C_RS}{K'N} \right)^{1/2} - (S - B)$$

$$C_T = \frac{2D}{K}\left(\frac{C_RS}{K'N} \right)^{1/2} - T \qquad (15)$$

Equation 15 assumes that rotary speed remains constant.

Another interesting approach to the problem considers only one interval with one bit. This can be developed as follows:

$$dC = \frac{BdD}{F} + \frac{C_RdD}{R} + C_R\,(A + C_RD)\,\frac{dD}{F}$$

$$C = \frac{BD}{F} + \frac{C_RD}{R} + \frac{C_RAD}{F} + \frac{C_RED^2}{2F}$$

$$C = \frac{D}{F}\left(B + C_RA + \frac{C_RED}{2} \right) + \frac{C_RD}{R} \qquad (16)$$

Where: $F = RL$ and $R = KWN$

then: $$L = \frac{K}{W^2N}$$

$$F = \frac{KK'}{W}$$

Let $$S = \frac{D}{F}\left(B + C_RA + \frac{C_RED}{2}\right)$$

to determine optimum weight for the one interval—determine minimum cost.

$$C = \frac{DS}{F} + \frac{C_RD}{R} = \frac{DSW}{KK'} + \frac{C_RD}{KWN}$$

$$\text{then: } \frac{dC}{dW} = 0 = \frac{DS}{KK'} - \frac{C_RD}{KW^2N}$$

$$W^2 = \frac{K'C_R}{SN}$$

$$W = \left(\frac{K'C_R}{SN}\right)^{1/2} \qquad (14)$$

Notice that optimum bit weight does not change.

To show how Equation 14 can be used, look at the following example. Assume that:

1. One bit can drill 500 ft. in uniform formation.
2. Rate of penetration is 20 ft. per hour.
3. Rotary speed is constant at 100 r.p.m.
4. Bit weight is 20,000 lb.
5. Cost of one bit is $200.
6. Rig operating cost is $50 per hour.
7. Round-trip time equals 1 hour of regular time. "A" and ½ hour per 1,000 ft. of depth.

For these conditions: $K = 10^{-5}$, $K' = 10^{12}$

	5,000 ft.	10,000 ft.	15,000 ft.	20,000 ft.
S =	312.50	375.00	437.50	500.00
W (N=100) lb. =	40,000	36,500	33,800	31,650
W (N=100) lb. =	28,300	25,900	23,900	22,400
W (N=100) lb. =	20,000	18,250	16,900	15,825
W (N=100) lb. =	13,320	12,167	11,267	10,550

A plot of optimum bit weights versus depth for a given rotary speed is shown in Fig. 15.

From this curve it is possible to plot an optimum rotary-speed curve for a given bit weight. Bit life is inversely proportional to rotary speed. This means essentially that a rock bit may be rotated a given number of r.p.m.; thus at 100 r.p.m. a bit will last only one-half as long as it would at 50 r.p.m.

However, the other assumption was that penetration rate is directly proportional to rotary speed so that any increase in r.p.m. will give a similar increase in the rate of penetration. As a result it may appear that increases in rotary speed would always minimize the cost of the drilling operation. However, look at Fig. 4 which shows optimum bit weights at given rotary speeds. At 100 r.p.m. and a depth of 5,000 ft. the optimum bit weight is 40,000 lb. On the other hand, if the rotary speed is increased to 200 r.p.m. the optimum bit weight is reduced to 28,300 lb. This means that at 40,000 lb. bit weight for our conditions, the optimum rotary speed is 100 r.p.m.

Following this, then, Fig. 16 shows a plot of optimum bit weight for a given depth, and the accompanying recommended optimum rotary speed. For example, if the bit weight was 30,000 lb. at a depth of 5,000 ft., then the optimum rotary speed would be 180 r.p.m.

Other things to consider . . . These data are based on bit-bearing life only. There are other factors which may have to be considered at high rotary speeds. Some of these are horsepower requirements for turning the rotary, abrasion of drill pipe, vibration of drill string, and drill-pipe twistoffs. The effect of these factors would have to be determined for a given area of operation. It is generally accepted that rotary speeds in excess of 300 r.p.m. are not practical. If wear on the bit teeth is the limiting factor then the above optimums do not apply and rotary speeds and bit weights should probably be in excess of those listed. However, it has been observed in field operations that at depths below 5,000 ft. bearing life is generally the determining factor in how long a bit may remain in the hole.

How to Find Optimum Bit Weight, Rotary Speed

When looking for optimum bit weight and rotary speed, the drillability of each formation must be considered. This appears to be a laborious job, but there is no reason why it should be. Cross-sections of a field to be developed are generally available, and it is reasonable to assume that drillability constants will be comparable from one well to another for a given formation. It is not difficult to obtain bit life and drilling rate for a given bit weight and rotary speed. When these are considered along with bit cost and rig-operating cost, an optimum bit weight and rotary speed may be selected as shown in Figs. 15 and 16. This, of course, is based on fluid properties that cause wear on the bit bearings as shown in Equation 1. If "a" should be some number larger or smaller than 2, Equation 1 for optimum bit weight in the same section, would be varied by this amount.

This, then, is a method of calculating an optimum bit weight and rotary speed for a given depth and formation drillability.

An optimum hydraulic horsepower may be selected after optimum bit weight and rotary speed are found. Each rig has a given amount of hydraulic horsepower available at the surface. Fig. 29 shows a method by which the bit horsepower may be maximized based on Equation 26. In this case, circulation rate is such that 67% of the total pressure drop is through the bit nozzles. This method of calculation is valid if the annular velocity can be maintained above 120 ft. per minute. If this method allows annular velocity to drop below 120 ft. per minute, pick a circulation rate that gives enough annular velocity and uses the maximum of horsepower available through the bit. To illustrate, Figs. 29 and 30 have been prepared to show how a hydraulics program may be designed by maximizing the hydraulic horsepower utilized at the bit.

3. How drilling rate is affected by

Drilling-Fluid Properties

AIR OR GAS, water, and mud, in that order are the preferred drilling fluids. Field tests have shown that penetration rate is faster and bit life longer with air as compared with water or mud. The same is true for water when compared to mud.

Figs. 16 and 17 compare drilling rates with air versus water for two 2,600-ft. wells. This comparison is made from surface casing seats at about 250 ft. to total depth. The well drilled with air was completed in 56¼ rotating hours using three bits. The offset well took 103 rotating hours and 7 bits to drill to about the same depth with water.

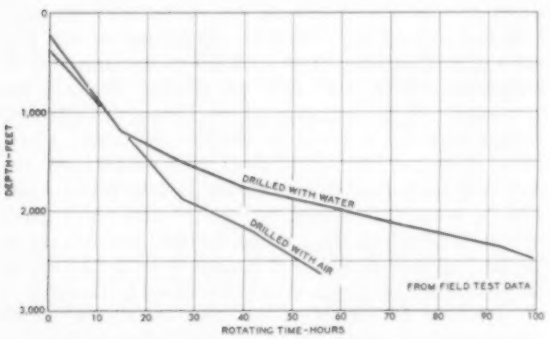
Fig. 18 compares drilling rates with gas versus mud. An interval from 1,500 to 9,504 ft. was drilled with mud in 90 days with 128 bits. An offset well was drilled from 1,594 to 9,950 ft. with gas in 14 days with 15 bits.

Further tests compared water with mud over an interval of several hundred feet. In this case, water and mud were used alternately through a variety of formations that were drilled at different rates. For this reason, penetration with water was set at 100%. Fig. 19 shows the drilling rates with mud as a relative per cent of the water drilling rate.

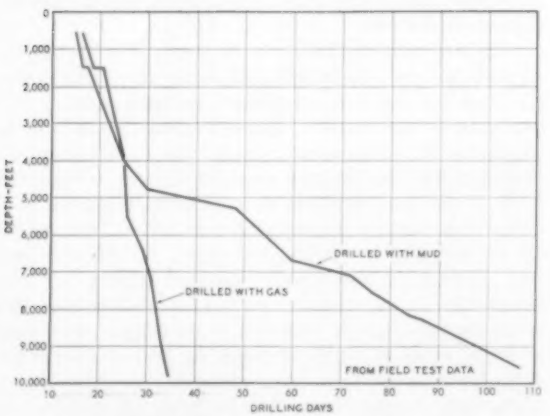
When jet bits were used, the drilling rates with mud were approximately 60% of the rate with water. When conventional bits were used, the rate of penetration with mud was only 40% of that with water. Any statement on what caused this difference is speculation. However, it is likely that drilling rate is a function of bottom-hole cleaning. As a result: (1) jet bits improve the cleaning effect of mud by directing the jet stream directly on the bottom of the hole thereby removing cuttings more efficiently, and (2) the jet velocities reduce the slower cleaning effect of a viscous fluid such as mud by reducing the effect of viscosity.

Regrinding of cuttings . . . Fig. 20 shows the way drilling rate may be retarded by drilling fluids or, rather, by the rate of circulation of these fluids. Note that, at circulation rates up to 3 g.p.m., there appears to be regrinding of particles regardless of the circulating fluid. Above 3 g.p.m., there does not appear to be any further regrinding of particles when using water. This indicates that, in this case, the 3 g.p.m is sufficient for hole cleaning.

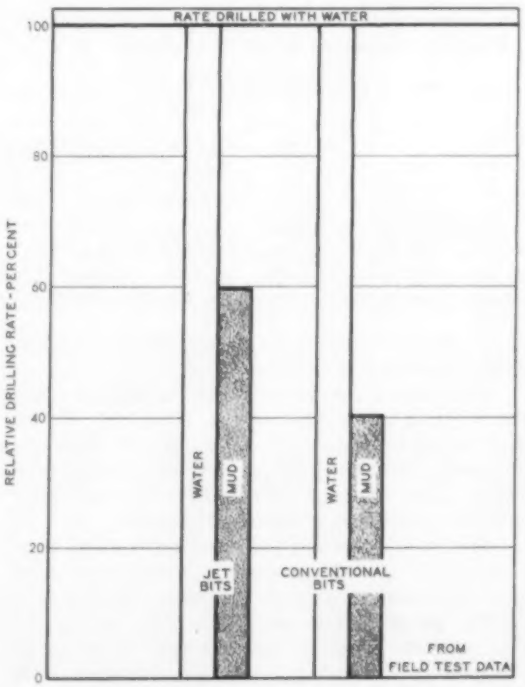
With mud, there is some regrinding of particles even at 11½ g.p.m., which is the maximum rate or circulation in this case. Thus, when circulating rates



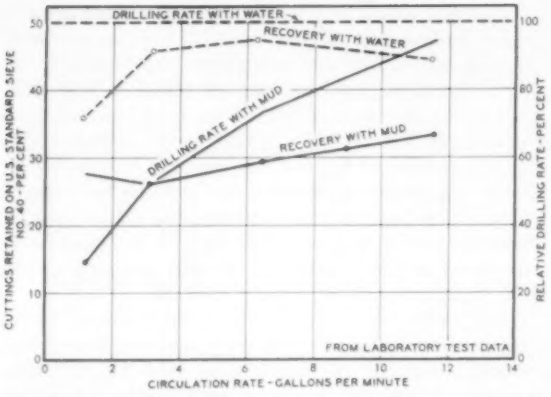
AIR AND WATER EFFECT on drilling time. Fig. 17



GAS AND MUD EFFECT on drilling time. Fig. 18.



MUD EFFECT on drilling time. Fig. 19.


DRILLING RATE WITH WATER
RECOVERY WITH WATER
DRILLING RATE WITH MUD
RECOVERY WITH MUD
FROM LABORATORY TEST DATA
CUTTINGS RETAINED ON U.S. STANDARD SIEVE NO. 40 - PER CENT
RELATIVE DRILLING RATE - PER CENT
CIRCULATION RATE - GALLONS PER MINUTE

EFFECT of circulation rate on recovery of cuttings and drilling rate. Fig. 20.

are the same, clear water is more effective than mud in initial removal of cuttings. Further, when a change is made from mud to water in the field, some of the loss in drilling rate might be prevented if horsepower were available for higher rates of circulation.

Effect of mud weight . . . We have already discussed how an increase in mud weight causes a decrease in drilling rate by increasing the hydrostatic pressure. There is a second reason why drilling rate may be reduced by mud weight. Assume that horsepower output is a maximum, which is frequently the case. Then, we may have the following situation:

$$\text{Maximum horsepower } Hp = \frac{PQ}{1714}$$

Drilling rate based on fundamentals of hydraulics; where drilling rate is proportional to bit horsepower, may be defined as follows:

$$R = KQV_N^2$$

Where:

Q = the volume rate of flow in g.p.m.
V_N = velocity of flow through the bit nozzles in feet per minute.
K = constant which is dependent on formation drillability.

Further:

$$V \propto \frac{Q}{D_B^2}$$

D_B = diameter of equivalent bit nozzle diameter which equals diameter of all nozzles

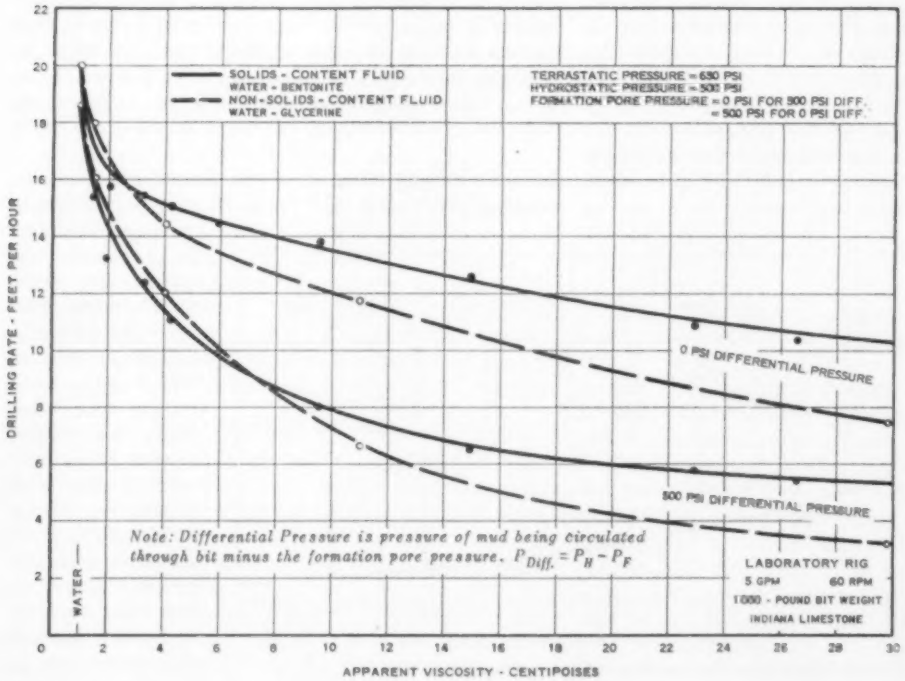
Therefore:

$$R = \frac{K \cdot Q^3}{D_B^4}$$

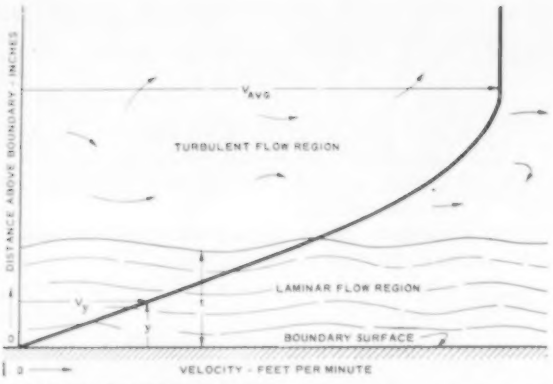
From this analysis then it can be seen that anything that limits the volume rate of flow also limits drilling rate.

An example . . . For example, take a drilling rate of 10 ft. per hour with a 10-lb. per gallon mud at maximum horsepower. If it is necessary to increase mud weight to 15 lb. per gallon, the rate with this new weight may be reduced to only 3.3 ft. per hour based on the effect of hydraulics alone. This new rate is based on accepted pressure drop equations which state that when mud is in turbulent flow pressure drop is proportional to mud density in pound per gallon.

From this analysis it can be seen that a 1.5 in-


SOLIDS - CONTENT FLUID
WATER - BENTONITE
NON-SOLIDS - CONTENT FLUID
WATER - GLYCERINE
TERRASTATIC PRESSURE = 630 PSI
HYDROSTATIC PRESSURE = 500 PSI
FORMATION PORE PRESSURE = 0 PSI FOR 900 PSI DIFF.
= 500 PSI FOR 0 PSI DIFF.
0 PSI DIFFERENTIAL PRESSURE
500 PSI DIFFERENTIAL PRESSURE
Note: Differential Pressure is pressure of mud being circulated through bit minus the formation pore pressure. $P_{Diff.} = P_H - P_F$
LABORATORY RIG
5 GPM 60 RPM
1000 - POUND BIT WEIGHT
INDIANA LIMESTONE
WATER
DRILLING RATE - FEET PER HOUR
APPARENT VISCOSITY - CENTIPOISES

EFFECT of solids in viscous fluids on drilling rate. Fig. 21.



VELOCITY CONDITIONS close to boundary area. Fig. 22.

crease in mud weight increases pressure drop 1.5 times and decreases the volume rate of flow by 1.5; therefore, if the nozzle diameter remains constant, drilling rate is reduced by $(1/1.5)^3$ or to .33 times its original rate. Probably in this case the nozzle diameter would have to be increased; and, although the actual net result may not be as shown, the rate of drilling could be expected to be reduced appreciably.

In summary, then, with the effect of the additional hydrostatic pressure plus this effect of reducing the available fluid flow the drilling rate may be only one-fourth the original 10 ft. per hour.

Effect of Viscosity

Another mud property found to have a significant effect on drilling rate, at least in laboratory investigations, is viscosity. Laboratory tests have shown that a change from clear water to nothing more than dirty water decreases in drilling rate 25%. This effect is shown in Fig. 21. Subsequent increases in viscosity continued to give a decrease in drilling rate, although to a lesser degree than in the low viscosity region.

This effect could be attributed to a combination of solids and viscosity, because as viscosity increased so did solids content. For this reason, another test was run using glycerin mixed in water to obtain a viscosity without solids. The results of this test, shown as the dotted curve in Fig. 21, indicate a greater reduction in drilling rate versus a given viscosity than was noted when solids were present.

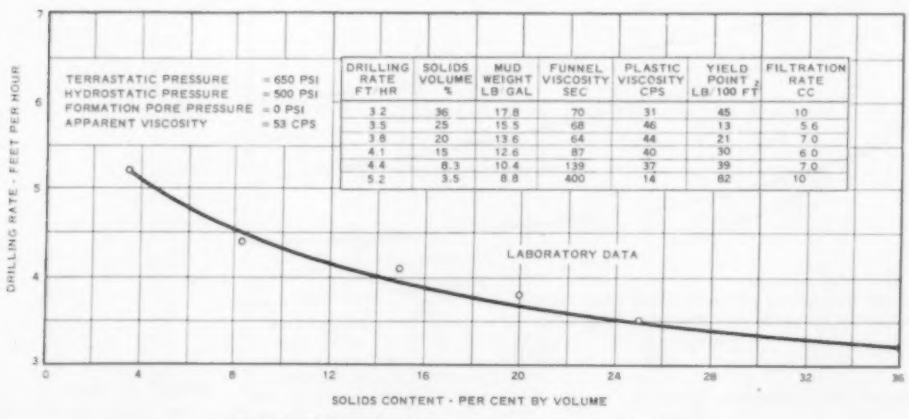
The first reaction to this is that solids were actually helping to increase drilling rate for a given viscosity. However, a further analysis shows that viscosity increases resulted from addition of solids in one case, while in the test with no solids, viscosity resulted from a change in the viscosity of the fluid medium. This may be significant for two reasons: (1) it may be desirable from the standpoint of penetration rate to utilize a fluid with a viscosity less than water, and (2) chemicals added to a mud will have to be analyzed to determine whether they add to the viscosity of the fluid medium when going into solution.

For example, it may be that the viscosity of the fluid medium is increased more by the addition of one chemical than by another that is used for the same purpose. Then, the chemical which affects viscosity less should be used.

Whatever the source . . . From Fig. 21 it is obvious that viscosity imparted to a fluid system by any means will tend to reduce drilling rates. The fundamental reason for this is uncertain; however, work has been done to explain it. There appear to be two logical reasons why viscosity slows down the rate of rock penetration: (1) the removal of bottom-hole cuttings is believed to be inversely proportional to viscosity, and (2) the more viscous fluids are slower to penetrate the minute fractures generated by the drilling bit in the rock than is a fluid such as water.

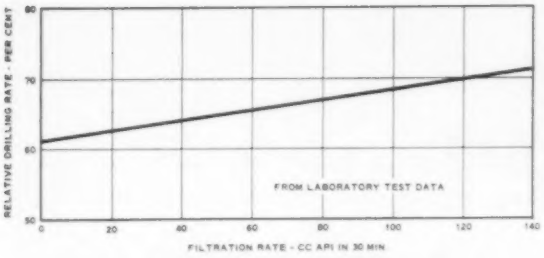
Lapple shows the effect of viscosity on bottom-hole cleaning. He shows that even though the flow of a Newtonian fluid may be turbulent the boundary velocity in a smooth pipe is zero, and next to this there is a layer of the fluid that is in laminar flow. Fig. 22 illustrates this. The velocity at distance Y will be proportional to the average velocity of the flow stream and inversely proportional to viscosity. The action of non-Newtonian fluids such as drilling mud, in general, follow this same pattern. Further, assume that the bottom of the hole is the boundary; then it can be seen that an increase in viscosity would have the effect of reducing fluid velocity adjacent to the bottom of the hole. This reduction in velocity would therefore reduce the effectiveness of cutting removal.

Second viscosity effect . . . The second effect of viscosity mentioned is believed principally a function of the pressure differential across the surface of some rocks during drilling. This differential is a result of the hydrostatic pressure being higher than the formation fluid pressure. As fracturing occurs, the rate at which chips can be removed from bottom will depend on how fast the differential pressure that exists can be

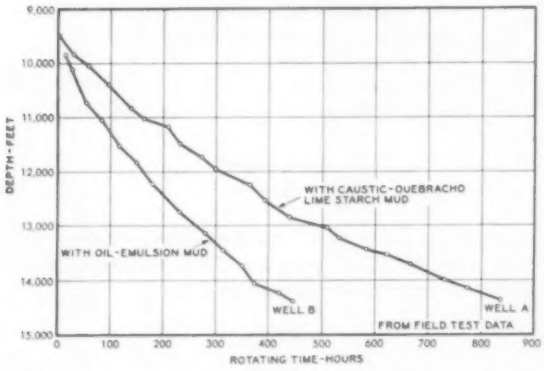

TERRASTATIC PRESSURE = 650 PSI
HYDROSTATIC PRESSURE = 500 PSI
FORMATION PORE PRESSURE = 0 PSI
APPARENT VISCOSITY = 53 CPS
DRILLING RATE - FEET PER HOUR
LABORATORY DATA
SOLIDS CONTENT - PER CENT BY VOLUME

DRILLING RATE FT/HR	SOLIDS VOLUME %	MUD WEIGHT LB/GAL	FUNNEL VISCOSITY SEC	PLASTIC VISCOSITY CPS	YIELD POINT LB/100 FT²	FILTRATION RATE CC
3.2	36	17.8	70	31	45	10
3.5	25	15.5	68	46	13	5.6
3.8	20	13.6	64	44	21	7.0
4.1	15	12.6	87	40	30	6.0
4.4	8.3	10.4	139	37	39	7.0
5.2	3.5	8.8	400	14	82	10

SOLIDS-CONTENT effect on drilling rate. Fig. 23.



FILTRATION-RATE effect on drilling rate. Fig. 24.



EFFECT of oil emulsion and conventional muds on drilling rate. Fig. 25.

equalized. The transmission of pressure in this case will depend on the rate at which the drilling fluids can penetrate the formation fractures made by the bit.

It is believed that this entry of fluid into the fractures is a function of the fluid viscosity. That is, the higher the viscosity the slower the entry and the longer the time that a pressure differential exists across the rock. This would increase regrinding of chips below the bit before they are removed.

Fig. 23 shows the effect of solids content on drilling rate. In this test, viscosity of the mud was held constant at 53 cp. and the pressure differential was 500 psi. Note that a decrease in solids content from 34 to 30% results in an increase in drilling rate of 0.1 ft. per hour for a 3% increase.

This could be the solids content range of 16-lb. per gallon mud. At lighter mud weights the solids content would be less and the difference in drilling rate for a given change in solids content would be greater. For example, a decrease in solids content from 12 to 8% resulted in an increase in drilling rate of 0.4 ft. per hour or about 9%. Likely solids slow down drilling rate because their presence below the bit increases the time required for the complete removal of formation cuttings.

Effect of Filtration Rate

Fig. 24 shows drilling rate versus filtration rate. It indicates that drilling rate increases as filtration rate increases. This same effect has been noted in the field. However, the field data were never plotted in graphical form because as filtration rate changed so did other properties of the mud.

There were slight decreases in viscosity that accompanied the filtration rate data from the laboratory. These decreases may account for the increase in drilling rate with increases in water loss. However, an effect similar to that shown in Fig. 24 has been observed by other operators who are studying effect of fluid properties on drilling rate.

To find why an increase in filtration rate also provides an increase in drilling rate, consider that some other property of the mud is changed by increasing the rate of filtration. For example, an increase in filtration rate, in many cases, is accompanied by a decrease in viscosity. The effect of viscosity on drilling rate is discussed above. Also, water-loss-control agents, in general, increase the viscosity of the fluid medium. And, it has been shown that such a change in the fluid-medium viscosity affects drilling rate more severely than does a change in the viscosity of a mixture caused by the addition of solids.

If filtration rates increase naturally, that is, not because of flocculation caused by contamination, the concentration of the water-loss-control agent is reduced. This, in effect, also reduces the viscosity of the fluid medium which results in an increase in drilling rate.

Effect of Oil

In addition to the changes in mud properties, field practice has shown that oil added to the mud increases penetration rates. An example of this is shown in Fig. 25. Well A was drilled to about 14,500 ft. in 840 rotating hours using a lime-treated mud. Well B was drilled to the same depth in 450 hours using an oil-emulsion mud.

Advantage of oil-emulsion muds shows up principally when drilling through shale sections. This fact suggests that the higher drilling rate results from better bit cleaning. In this case, it is assumed that with oil present clays did not tend to ball up the bit. As a result, bit weight was more effective. In addition, lubrication by the oil helps lengthen bit bearing life.

None of the data on drilling rate versus oil concentration are in relative agreement. Actually optimum oil percentage depends on type formation, bit weight, and whether there is enough horsepower to remove cuttings. Since this is the case, only experimenting will show the optimum oil percentages to be used in field development programs. Maximum rates of penetration seem to result with oil concentrations between 4 and 15%. For this reason, first tests of the effect of oil on rate of penetration should be conducted with an oil concentration of about 4%. They should then be increased, say 2% at a time, to some maximum, say 12 to 15%.

Remember this is an economic analysis. You must consider the cost of oil versus money saved by the increase in drilling rate. If a centrifuge is used on a weighted mud system, a low percentage of oil likely will be best. The centrifuge discards oil with the effluent and the maintenance of a high oil percentage is costly.

In summary, if mud is used, highest drilling rates will result from the use of minimum mud weights and viscosity, and maximum rates of filtration. And if drilling in shale or other sticky-type formations, through the use of oil emulsified in the mud. If higher viscosity is necessary, then rate of penetration may be kept high by increasing hydraulic horsepower; this is because cleaning and removal of bottom-hole chips is also a function of viscosity.

4. How drilling rate is affected by

Hydraulic Horsepower

HYDRAULIC HORSEPOWER is the circulation rate multiplied by the pressure. Using units common to drilling rigs, hydraulic horsepower is:

$$H_P = \frac{PQ}{1714}$$

Where:

H_P = horsepower
P = pressure in psi.
Q = fluid flow rate in g.p.m.
1714 = a constant for units conversion to horsepower.

Hydraulic horsepower measured at the surface is the total horsepower provided by the pumps. The horsepower developed through the bit is the same as in the above equation; however, the pressure will be the drop in pressure going through the bit nozzles; the volume rate of flow will remain the total fluid discharge from the pumps.

In unpublished work, Humble Oil & Refining Co. shows that there is an optimum rate of circulation to obtain maximum bottom-hole cleaning. This rate of circulation may be above or below that required for an adequate annular velocity. Also, this work shows that drilling rate is proportional to the impact force through the bit rather than bit hydraulic horsepower. These two differ in that impact involves the product of circulation rate times velocity, and bit hydraulic horsepower is the product of circulation rate times the square of the velocity.

Generally, an increase in either bit horsepower or impact will increase drilling rate. The primary purpose in either is to clean the bottom of the hole of cuttings to prevent regrinding; neither function is believed to make hole. It is easy to see that a point could be reached, regardless of the method, where further increases in hydraulic horsepower or impact will have no effect on drilling rate. This is the point where cuttings are being removed instantaneously upon generation.

Getting rate from horsepower . . . Of course the amount of necesary cleaning below the bit will vary with the type formation, drilling rate, and type of fluid. The following discussion will develop equations that predict either optimum bit horsepower or impact through the bit. Bit hydraulic horsepower may be defined:

$$H_B = \frac{P_B Q}{1714} \qquad (18)$$

Where:

H_B = hydraulic bit horsepower
P_B = pressure drop through the bit nozzles
Q = volume rate of flow in g.p.m.
1714 = a unit's conversion constant
R = drilling rate.

If we assume drilling rate proportional to bit horsepower:

$$R \propto \frac{P_B Q}{1714} \qquad (19)$$

Next, consider that pressure drop through the bit nozzles is essentially proportional to

$$\frac{Q^2}{D_B^4}$$

The drilling rate can now be defined as

$$R = \frac{KQ^3}{D_B^4} \qquad (20)$$

Where:

K = drillability constant
D_B = effective diameter of bit nozzles.

Considering nozzle velocity V_N proportional to the volume rate of flow and inversely proportional to the nozzle diameter squared D_B^2, Equation 20 may be written:

$$R = K'QV_N^2 \qquad (21)$$

Where:

V_N = velocity in feet/second through bit nozzles.

This is the fundamental equation for drilling rate as a function of bit horsepower.

To get the optimum . . . To determine the optimum conditions for maximum drilling rate, first consider the total output horsepower at the surface

$$\frac{P_S Q}{1714},$$

as being equal to bit horsepower plus the horsepower loss in the circulating system.

This may be written:

$$H_S = \frac{P_S Q}{1714} = H_B + \frac{P_D Q}{1714} \qquad (22)$$

Where:

H_S = surface hydraulic horsepower
P_S = surface pump pressure
P_D = pressure drop in circulating system excluding that through the bit.

Pressure drop in the circulating system is proportional to Q^2 and may be written as $P_D = KQ^2$.

Then Equation 22 may be written:

$$\frac{P_S Q}{1714} = \frac{H_B + KQ^3}{1714}$$

(and horsepower at the bit can be written as) (23)

$$H_B = \frac{P_S Q}{1714} - \frac{KQ^3}{1714}$$

At maximum conditions and constant horsepower at the surface

$$\frac{dH}{dQ} = \frac{P_S}{1714} - \frac{3KQ^2}{1714} = 0$$

$$P_S = 3KQ^2 \quad (24)$$

Then:

$$P_S = 3P_D$$

$$P_D = 0.33\ P_S \quad (25)$$

$$P_B = 0.67\ P_S \text{ or } H_B = 0.67\ H_S \quad (26)$$

Based on Equation 26 the pressure drop through the bit is 67% of the total surface pressure output at a given rate of circulation.

For impact . . . Some operators believe drilling rate is a function of impact through the bit. The following is a derivation of the Eckel and Bielstein equation for optimum impact. By definition, drilling rate is stated:

$$R = K'QV_N \quad (27)$$

The nozzle velocity V_N is proportional to the volume rate of flow and inversely proportional to the effective nozzle diameter squared. Therefore, Equation 27 may be written:

$$R = \frac{KQ^2}{D_B^2} \quad (28)$$

K and K′ are formation drillability constants.

Total horsepower was given in Equation 22; it may be restated:

$$H_S = \frac{GQ^3}{1714} + \frac{\epsilon Q^3}{D_B^4 1714} \quad (29)$$

where G is a constant depending on the geometry of the circulating system and ϵ is a constant depending on nozzle shape.

Solving for D_B^2 Equation 29 may be rewritten:

$$D_B^2 = \left(\frac{\epsilon Q^3}{1714\ H_S - GQ3} \right)^{1/2} \quad (30)$$

substituting this value of D_B^2 in Equation 28 drilling rate may be stated:

$$R = K \left[\frac{(1714\ QH_S - GQ^4)}{\epsilon} \right]^{1/2} \quad (31)$$

Maximizing drilling rate as a function of circulating rate

$$\frac{dR}{dQ} = \frac{K}{2} \left(\frac{1714\ QH_S - GQ^4}{\epsilon} \right)^{-1/2} \times \left(\frac{1714\ H_S - 4\ GQ^3}{\epsilon} \right) = 0$$

gives the total pressure drop at the optimum circulating rate as follows:

$$1714\ H_S = 4\ GQ^3$$

$$H_S = \frac{4\ GQ^3}{1714} \quad (32)$$

Note from Equation 29 that the total horsepower used in the circulating system, excluding that through the bit, was defined as

$$\frac{GQ}{1714}.$$

Dividing this by Equation 32 shows that one-fourth of the total horsepower is used in the circulating system or that:

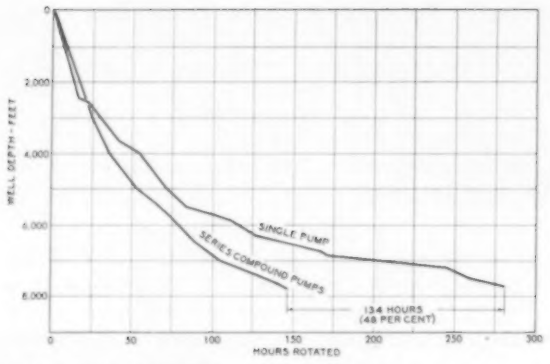
$$H_B = 0.75\ H_S \text{ or } P_B = 0.75\ P_S$$

which simply states that 75% of the surface pressure or expended surface horsepower should be used through the bit for optimum impact.

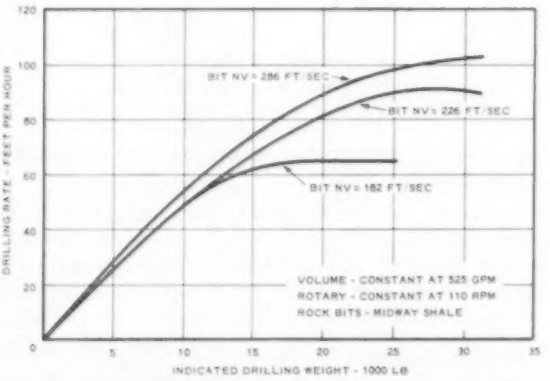
Summing up . . . Then, if surface pressure is limited to some maximum amount, the circulation rate based on bit horsepower should allow a drop of 67% of the total surface pressure through the bit nozzles.

The circulation rate must be high enough to give an annular velocity that is adequate to remove cuttings. This velocity may very between 90 and 150 ft. per minute. Generally, an annular velocity of 120 ft. per minute is considered adequate. As a result it may be necessary to operate below optimum conditions, if the maximum surface pressure is limited.

Sometimes the limiting condition is surface horsepower. Then it may not be possible to get 67% of the pressure drop through the bit and still maintain an adequate annular velocity. In such cases, increasing surface horsepower might pay off. This, of course, depends on the type formation being drilled and assumes that more bit horsepower will prevent regrinding of cuttings.



SINGLE-PUMP OPERATIONS compared with compound-pump operations. Fig. 26.


DRILLING RATE - FEET PER HOUR
BIT NV = 286 FT/SEC
BIT NV = 226 FT/SEC
BIT NV = 182 FT/SEC
VOLUME - CONSTANT AT 525 GPM
ROTARY - CONSTANT AT 110 RPM
ROCK BITS - MIDWAY SHALE
INDICATED DRILLING WEIGHT - 1000 LB

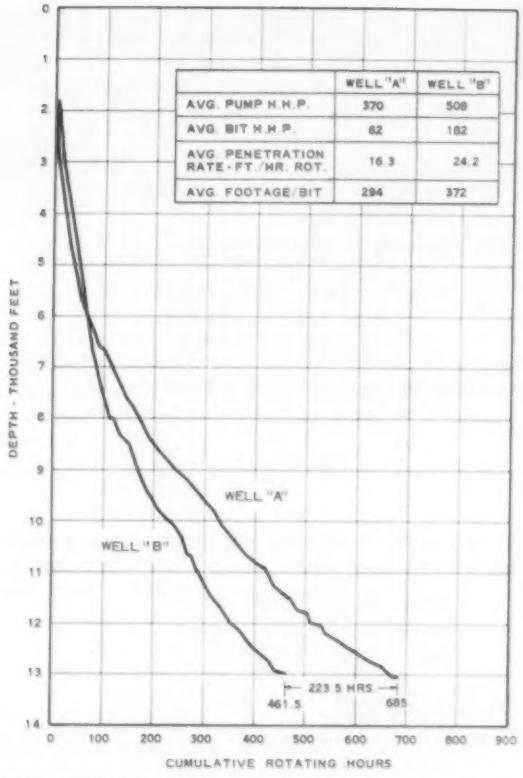
EFFECT of bit nozzle velocity and bit weight on drilling rate. Fig. 28.

What field tests show . . . Fig. 26 illustrates how increases in hydraulic horsepower affect drilling rate. This figure compares the effect of running surface pumps in compound, to increase available horsepower, versus single pump operation. Note that the rotating time with pumps compounded was only slightly more than half of that for single pump operations. These field tests were performed by the same rig in offset wells with all other factors constant.

The only increase in hydraulic horsepower noted here is at the surface. However, it is obvious that any increase in surface horsepower with all other factors constant will also result in an increase in bit horsepower. While no calculations were made on actual horsepower generated, this does illustrate what often can be done to increase drilling rates with a minimum of planning.

Fig. 27 shows drilling rate as a function of surface horsepower and bit horsepower. When 138 hp. was added at the surface, drilling rates went up 50%. In addition, each bit got 27% more footage. This increased footage is a result of the fact there was more regrinding at the lower horsepower.

Bit weight, nozzle velocity . . . Fig. 28 shows drilling rate as a function of bit weight and fluid nozzle velocity. Up to a bit weight of 5,000 lb. the nozzle velocity had practically no effect on drilling rate. Note that at a nozzle velocity of 182 ft. per second, rate of penetration was a maximum at about 18,000 lb. of bit



COMPARISON of rotating time vs. hydraulic horsepower. Fig. 27.

weight. At a nozzle velocity of 226 ft. per second, penetration rate was at a maximum at about 27,000 lb. of bit weight.

This test is significant for several reasons. It is obvious that an increase in drilling rate with an increase in bit weight, depends on adequate hole cleaning ahead of the bit. This explains why drilling rate is not always increased with an increase in bit weight.

As stated previously, bit hydraulic horsepower serves one function—to clean the formation cuttings from below the bit before they can be reground. You might assume that for a given rate of drilling at a given rotary speed and bit weight there is also a given hydraulic bit horsepower necessary to maintain hole cleaning. This is not true for the following reasons: (1) a shale may be drilled at the same rate as a section of sand; however, there is no question that more cleaning would be required to remove the shale cuttings than the sand cuttings, and (2) two formations exactly alike may be drilled at the same rate with two identical fluids; however, raise the mud weight or viscosity of one of the fluids and for a given rotary speed and bit weight the formation drillability is lower and hydraulic horsepower requirements may remain the same.

Getting optimum horsepower . . . These facts do not eliminate the possibility of determining an optimum bit horsepower for a given area. This may be done under three conditions: First, consider an area where an optimum bit weight and rotary speed have been calculated and experimentally determined. The optimum horsepower is the minimum that will give adequate

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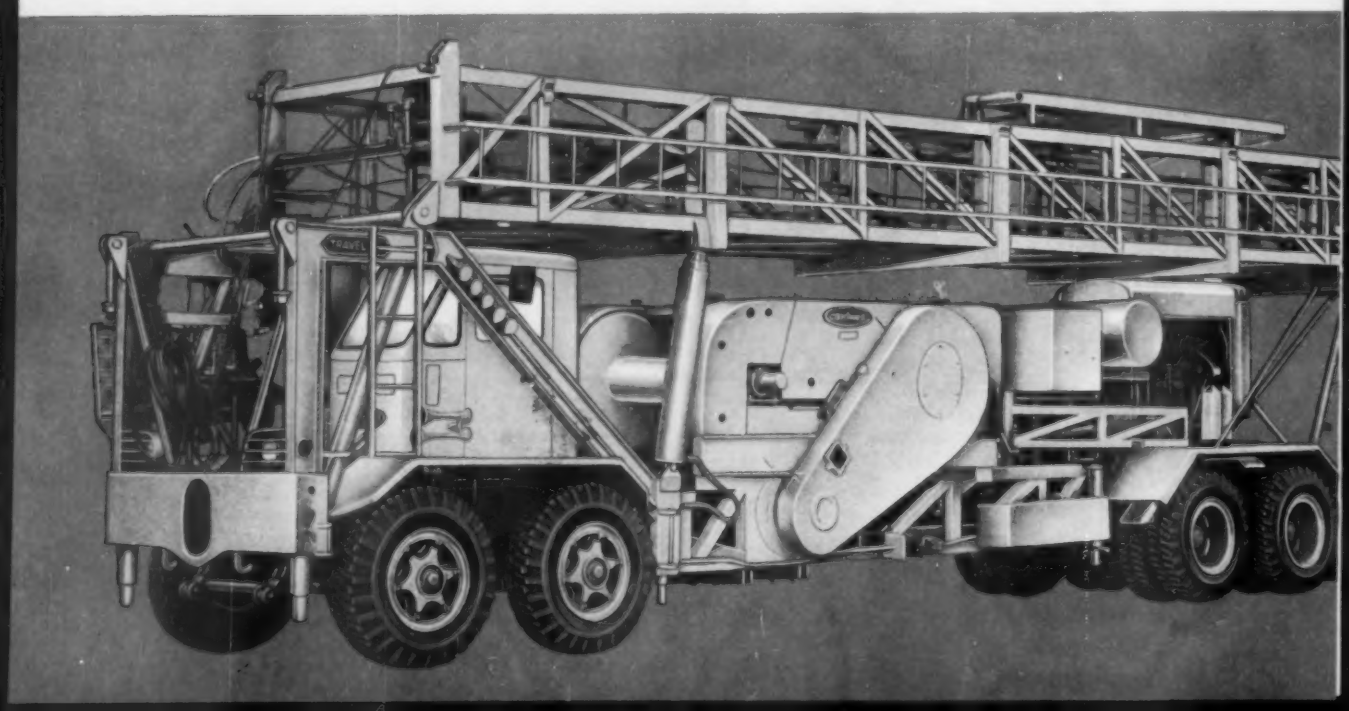

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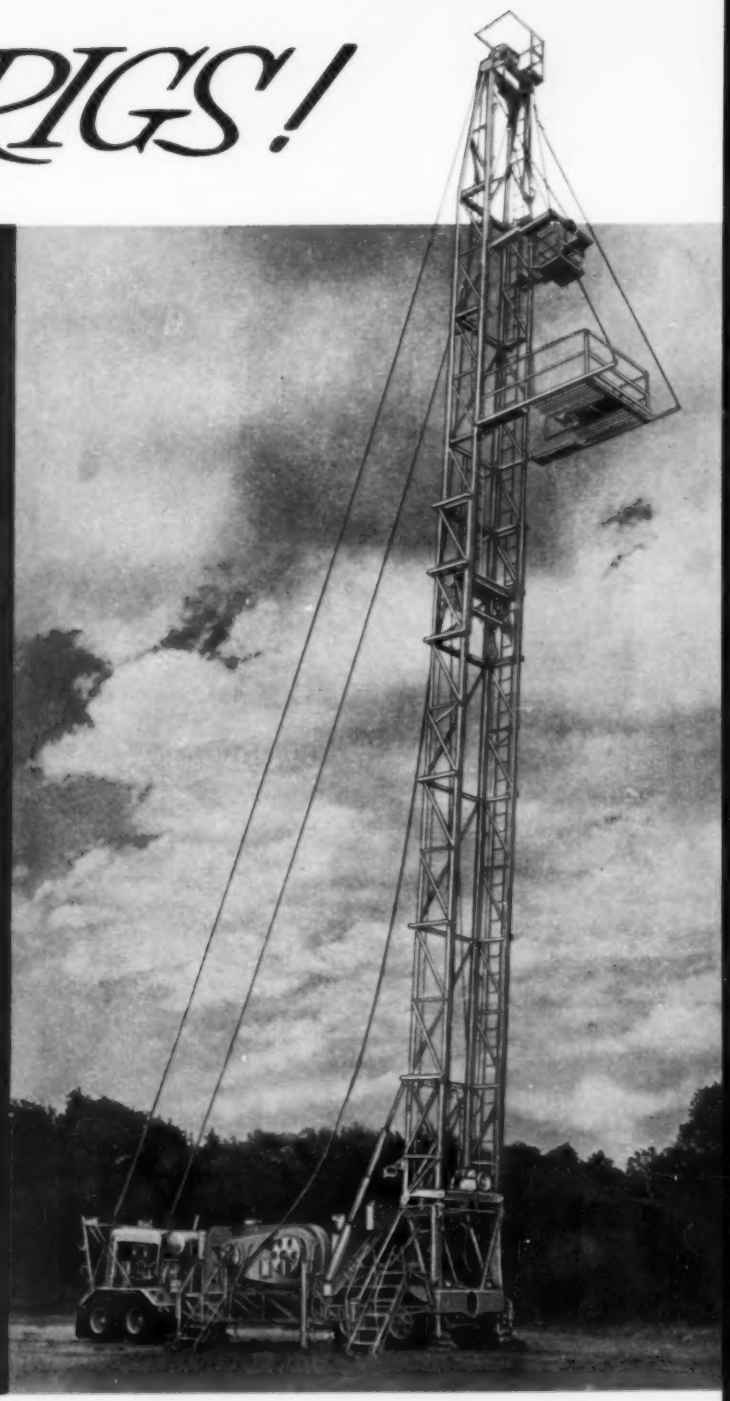

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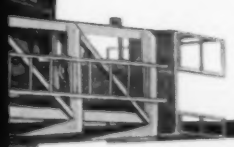

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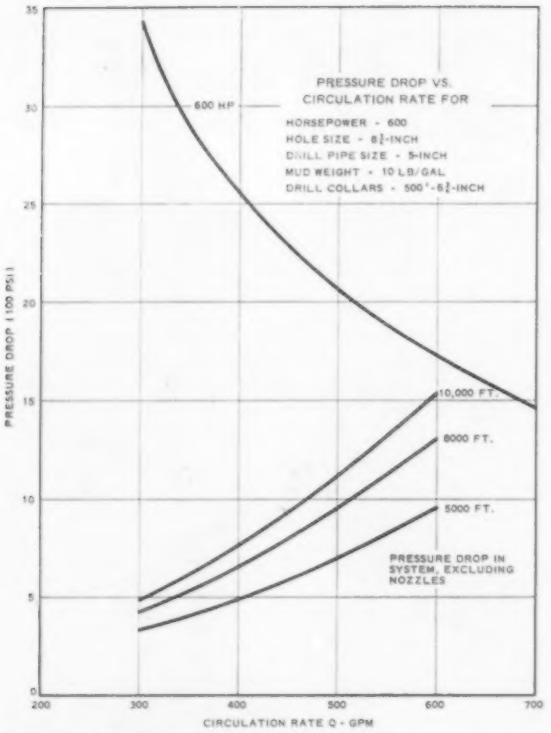


CALCULATED CURVE for estimating optimum circulating rate. Fig. 29.

bottom-hole cleaning. In other words, it is the minimum that will keep penetration rate as a linear function of the product of rotary sped and bit weight.

Second, consider a rig with surface connections that will not limit total pressure. The circulation rate should be one that will permit 67% of the total pressure drop through the bit. Of course, this is provided that annular velocity will be adequate.

Third, a cross-section of underground formations and a record of their drillabilities can be used. These provide a basis from which to calculate optimum techniques and horsepower.

In summary, optimum horsepower must first be based on a predetermined optimum bit weight and rotary speed in a particular formation. If some factor, say mud weight, changes, surface horsepower must be varied to maintain the same bit horsepower.

A sample problem . . . The following example shows a method of calculating optimum bit horsepower:

Well Data:

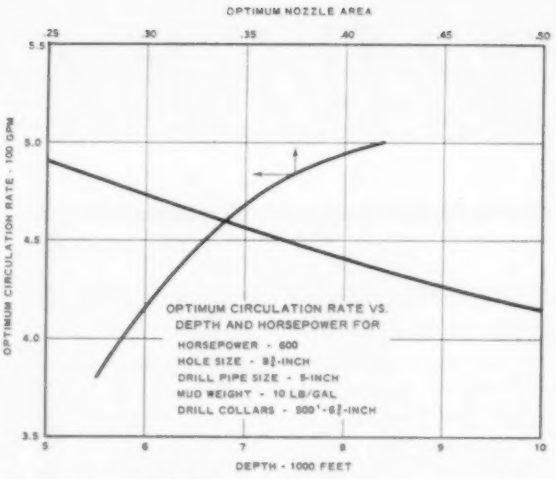
1. Projected well depth is 10,000 ft.
2. Hole size is 8¾ in.
3. Drill pipe size is 5 in.
4. 10¾ in. surface casing is set at 4,000 ft.
5. Mud weight is 10 lb. per gal.
6. 500 ft. of 6¼ in. drill collars.

Rig Data:

1. Maximum surface horsepower available is 600
2. Pump stroke is 20 in.
3. No limitation on surface pressure

Problem: Determine optimum bit horsepower.

For the solution to this problem, refer to Fig. 29.


OPTIMUM NOZZLE AREA
OPTIMUM CIRCULATION RATE - 100 GPM
OPTIMUM CIRCULATION RATE VS.
DEPTH AND HORSEPOWER FOR
HORSEPOWER - 600
HOLE SIZE - 8¾-INCH
DRILL PIPE SIZE - 5-INCH
MUD WEIGHT - 10 LB/GAL
DRILL COLLARS - 500'-6¼-INCH
DEPTH - 1000 FEET

CALCULATED CURVE for estimating optimum circulation rate and nozzle area. Fig. 30.

The 600-hp. curve is based on the formula

$$P = \frac{1714\,H}{Q}.$$

The curves shown at specific depths are based on the total pressure drop at that depth in the complete circulating system exclusive of nozzles. Note that at 5,000 ft. the optimum rate of circulation is about 510 g.p.m. This would give a pressure drop of 33% of the total available in the circulating system, and 67% can be used at the bit. At 10,000 ft., the circulation rate would be 425 g.p.m. at optimum conditions.

For an annular velocity of 150 ft. per minute in the hole-drill-pipe annulus and 120 ft. per minute in the casing-drill-pipe annulus, flow rate must be 320 g.p.m. If the rig had less than 600 hp., this rate of flow could be the limiting condition.

Fig. 30 is another example of how quickly design charts might be organized to calculate a hydraulics program. This chart plots optimum circulating rate versus depth. Find the optimum nozzle area by proceeding horizontally from the optimum circulating rate across to the curve of nozzle area.

Optimum drilling techniques . . . Obviously the purpose of investigating all the factors that affect drilling rate is so we may use them to drill a foot of hole for a minimum of cost. This then could be termed the optimum drilling techniques, first explored by Speer. He presents data that he claims will permit the selection of optimum bit weight, rotary speeds, and hydraulics. Speer took a combination of field data, mostly from California, and theoretical calculations to select optimum bit weights and rotary speeds. He uses surface hydraulic horsepower as a basis for selecting the optimum horsepower requirements. This work presents a good study of steps that may be taken on a field experimental basis to obtain optimum drilling techniques. However, use of surface hydraulic horsepower is questionable and industry, in general, uses either bit hydraulic horsepower or impact through the bit.

Congrats and $25 to Mr. D. J. SUGGS, Republic Natural Gas Co., Tipton Bldg., Pauls Valley, Okla., for this quip.

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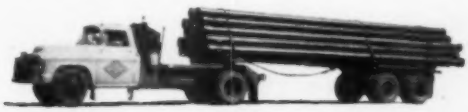

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Can you speed drilling rate?

HERE IS AN EXAMPLE to show the need for carefully controlling the factors that affect drilling rate. These conditions might exist while drilling in a normal pressure area. And making the changes shown could be expected to increase the drilling rate thusly:

Well conditions	Before changes	After changes
Well depth—ft.	8,000	8,000
Mud weight—lb./gal.	10.2	9.5
Viscosity—cp.	30	15
Solids content—%	22	14
Filtration rate—cc.	8	25
Rotary speed—r.p.m.	90	120
Bit weight—lb.	15,000	30,000
Hydraulic horsepower required	300	600
Drilling rate—ft./hr.	5	23.6

The effect of each factor above is based on actual tests. Here, the calculations are made in stepwise order to show the relative effect of each on drilling rate.

1. **Effect of lowering mud weight from 10.2 to 9.5 lb./gal.**

a. Compaction effect due to hydrostatic pressure in well bore. This is based on results obtained in the laboratory while drilling in Leuders limestone and assumes a normal formation pressure gradient of 0.465 psi./ft. to 8,000 ft. Data obtained from Fig. 3. Rotary speed 90 r.p.m.

Mud weight lb./gal.	Pressure gradient psi./ft.	Overbalance at 8,000 ft. psi.	Drilling rate Leuders limestone ft./hr.	Per cent increase in drilling rate
10.2	0.530	520	22.0	
9.5	0.494	232	26.5	20.5

$$\text{Per cent increase} = \frac{26.5 - 22.0}{22.0} = 20.5\%$$

Increase in drilling rate = 5 x 0.205 = ft./hr.

b. Hydraulics effect.

This effect is a calculated effect and is based on the equation,

$$R_2 = R_1 \frac{(P_1)^3}{(P_2)}$$

Where R_2 and R_1 are the drilling rates and P is the mud density in lb./gal.

$$R_2 = \frac{5(10.2)^3}{(9.5)} = 5.8 \text{ ft./hr.}$$

Increase in drilling rate = 5.8 — 5 = 0.8 ft./hr. Combining the effects of compaction and hydraulics, the reduction in weight causes an increase of 1.8 ft./hr. (1.0 + 0.8) in drilling rate. Then, reducing the mud weight alone will increase the rate of drilling to 6.8 ft./hr.

2. **Effect of lowering viscosity from 30 to 15 cp.**

Referring to Fig. 21, at 15 cp. the drilling rate is 6.5 ft./hr. and at 30 cp. the drilling rate is 5.1 ft./hr.

$$\text{Per cent increase is} \frac{6.5 - 5.1}{5.1} = 27.5$$

Applying these data to the current problem, increase in drilling rate = 0.275 x 6.8 = 1.9 ft./hr. Total drilling rate after reducing the mud weight and lowering viscosity = 8.7 ft./hr. (6.8 + 1.9).

3. **Effect of lowering solids content from 22 to 14%.**

Referring to Fig. 23, at 22% solids the drilling rate is 3.7 ft./hr. At 14% solids the drilling rate is 4.1 ft./hr.

$$\text{Per cent increase} = \frac{4.1 - 3.7}{3.7} = 10.8\%.$$

Applying these data to the current problem, increase in drilling rate = 0.108 x 8.7 = 0.9 ft./hr.

Total drilling rate after decreasing mud weight, viscosity, and solids content is 9.6 ft./hr. (8.7 + 0.9).

4. **Effect of increasing filtration rate from 8 to 25 cc.**

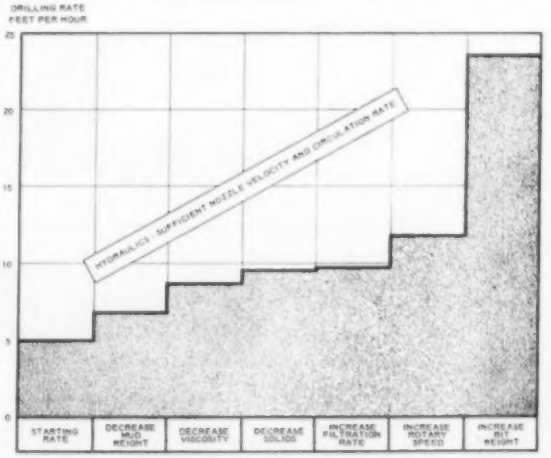
Referring to Fig. 24, the relative drilling rate at 8 cc. is shown to be 62%, and at 25 cc. about 63%; this is a 1% increase. Increase in drilling rate = 9.6 x 0.01 = 0.1 ft./hr. Total drilling rate after reducing mud weight, viscosity, and solids content and raising the filtration rate is 9.7 ft./hr. (9.6 + 0.1).

5. **Effect of increasing rotary speed from 90 to 120 r.p.m.**

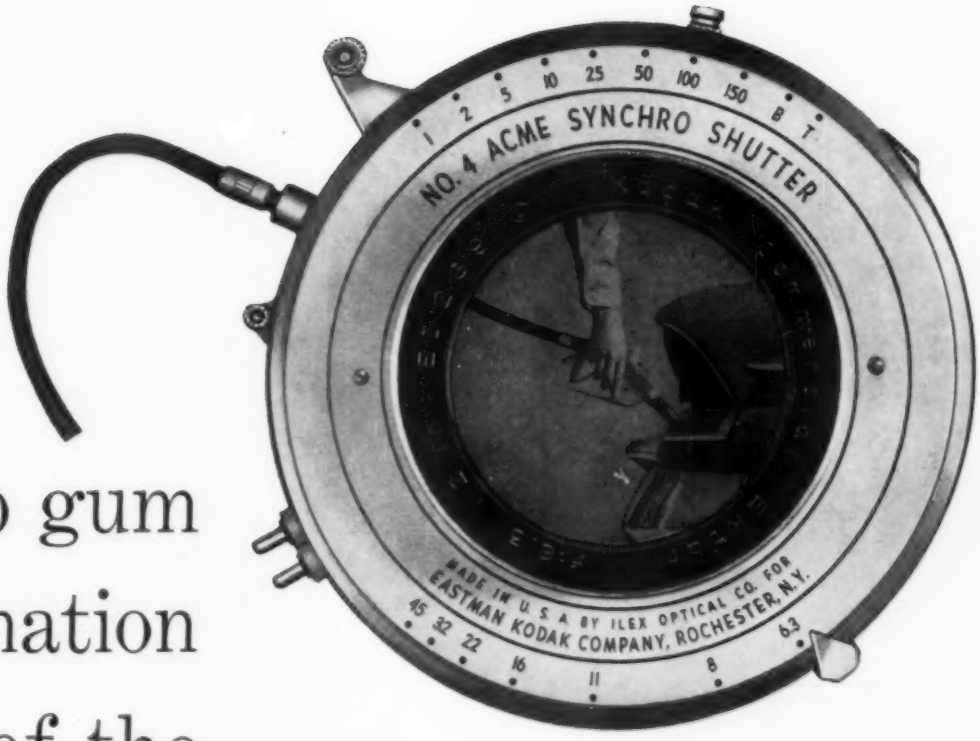
Based on Fig. 10, raising rotary speed from 90 to 120 r.p.m. brought a 22% increase in drilling rate. Therefore, 9.5 x 1.22 = 11.6 ft./hr. Total drilling rate after reducing mud weight, viscosity, and solids content and increasing filtration rate and rotary speed is 11.6 ft./hr.

6. **Effect of increasing bit weight from 15,000 to 30,000 lb.**

Drilling rate is directly proportional to bit weight;



ACCUMULATIVE EFFECT of drilling practices on drilling rate. Fig. 31.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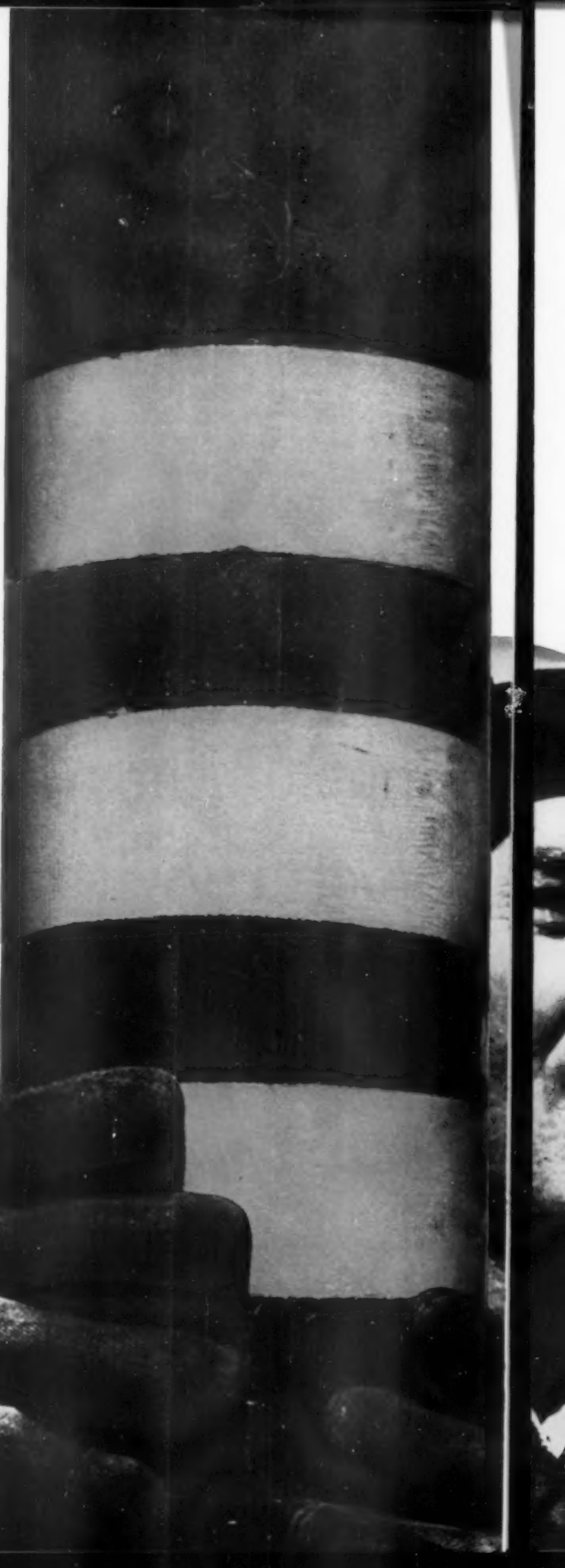


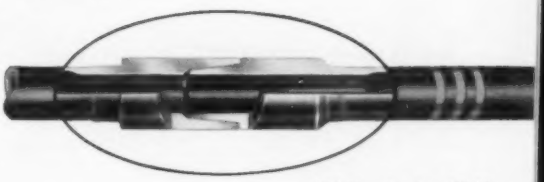
PERFORMANCE PROPERTIES AND SETTING DEPTHS

LIGHTWEIGHT GRADE E DRILL PIPE

SIZE (OD)	INCHES	2⅞"	3½"	4"	4½"	5"
Weight*	Lb./Ft.	6.85	9.50	11.85	13.75	15.0
Wall Thickness	Inches	.217	.254	.262	.271	.296
Tension Data (Minimum Values)						
Load at Minimum Yield	Lbs.	135,900	194,270	230,760	270,030	328,070
Equivalent Length	Ft.	19,840	20,450	19,480	19,640	21,870
Collapse Data (Minimum Values)						
Collapse Pressure	PSI	8,380	8,080	7,080	6,290	6,140
Setting Depth (S.F. – 1%)	Ft.	14,900	14,370	12,590	11,180	10,920
Internal Pressure at Minimum Yield	PSI	9,980	9,600	8,660	7,900	7,830

*Tension API Weight

YOUNGSTOWN LIGHTWEIGHT DRILL PIPE



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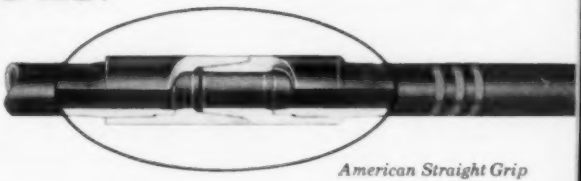

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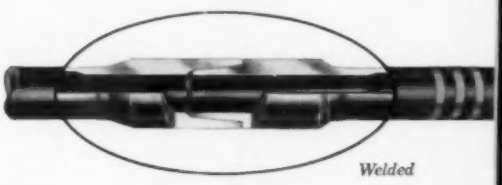
Now, Youngstown provides a lightweight drill pipe that will substantially extend your bidding range. You can bid and *get* those deeper drilling contracts—without any changes in your present rig.

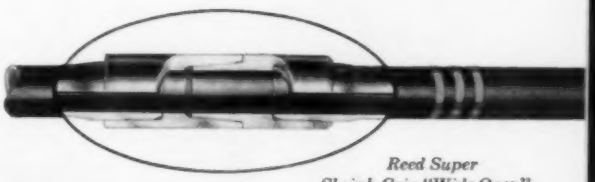
You get more rotating hours with this Orange Band pipe. From ore through final inspection, it is manufactured to rigid drill pipe specifications . . . not a tubing substitute.

On a 10,000-foot hole, a string of 4½" lightweight drill pipe is 18½ tons lighter than 4½" regular drill pipe—because it's 2.85 pounds lighter per lineal foot. This means longer drill strings *without increased weight.*



Welded

Since a larger ID is used, hydraulic efficiency (on a 10,000-foot string, 16.7% less pressure drop in drilling fluid column) is improved for longer slush pump rod and bearing life . . . plus a lowering of horsepower requirements.



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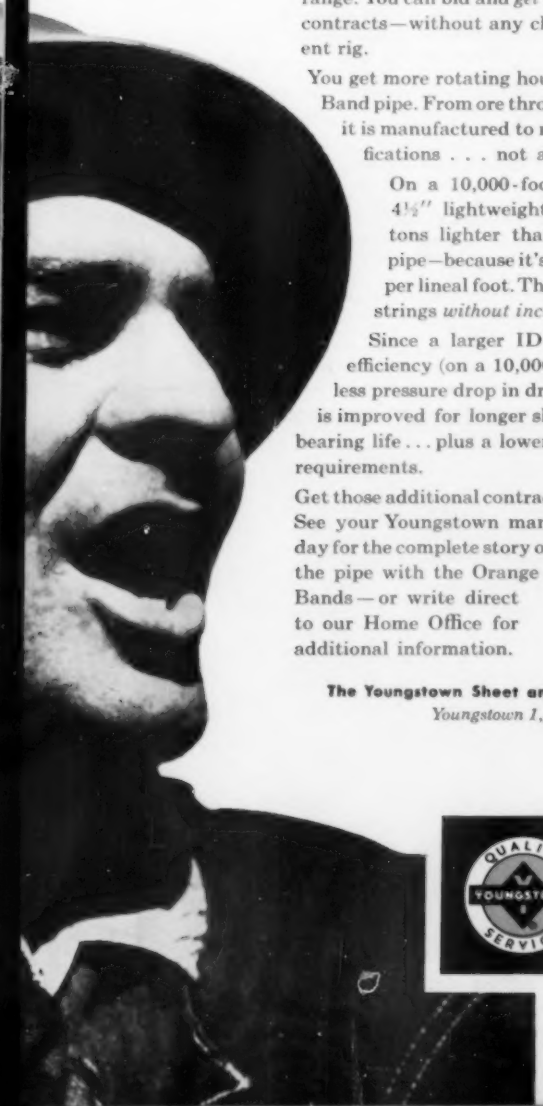

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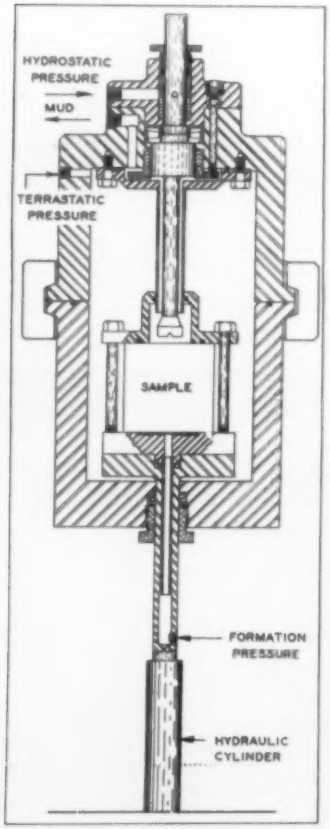
therefore, doubling bit weight will also double drilling rate. The total drilling rate after decreasing mud weight, viscosity, and solids content and increasing filtration rate, rotary speed, and bit weight is 23.2 ft./hr. (11.6 x 2).

Thus, by improving drilling practices, it is calculated that the drilling rate would increase from 5 to 23.2 ft./hr. Fig. 31 is a graphical summary of the above changes.

Lab equipment and technique

THE EQUIPMENT USED in the laboratory investigation of factors affecting rock penetration is shown in Fig. 32. The four-legged mast in the right-hand side of Fig. 32 supports the pressure chamber, which in this case simulates the well being drilled. A cross-section of this chamber is shown in Fig. 33. Note that three different pressures can be applied to the sample being drilled. Terrastatic pressure, or over-burden pressure, is applied around the outside of the rock. Hydrostatic pressure, or that imposed by the fluid column, is obtained by circulating in a closed pressure system. Formation pressure, or that of formation fluids, is obtained by injecting fluid into the bottom of the rock to some predetermined pressure. The sample is coated with epoxy resin to separate the pressures. Then, the sample is clamped between the steel plates that contain O-ring seals.

At the top of the mast in Fig. 32, is shown a right-angle gear box that turns the bit.



MICROBIT drilling unit shows cross-section of pressure chamber. Fig. 33.

FACTORS THAT AFFECT THE RATE OF ROCK PENETRATION

Table of Nomenclature

A — cost of handling and changing (non-hole-making function)
a — exponent applied to bit weight (W) to introduce effect of drilling fluid
α — angle of failure in shear
B — bit cost, dollars
C_1 — total bit cost, dollars
C_2 — total rotating time cost, dollars
C_3 — total round trip time cost, dollars
C_R — rig cost, dollars per hour
C_T — total drilling cost
D — well depth, feet
D_n — equivalent bit nozzle diameter
E — rate of increase of trip time with depth
ϵ — constant of nozzle shape
F — footage per bit
f — Fanning friction factor
G — constant of geometry of circulating system
H_H — bit hydraulic horsepower
Hp — horsepower
H_s — surface hydraulic horsepower
H_s — surface hydrauli horsepower
K, K_1 — constants of proportionality
L — bit life, hours
M — depth of bit change, ft.
μ — fluid viscosity, cp.
N — rotary speed, r.p.m.
N_B — boundary porosity, %
n — total number of trips
P — pressure, psi.
P_B — pressure drop through bit nozzles, psi.
P_C — hydrostatic or confining pressure, psi.
P_D — pressure drop in circulating system, psi.
P_S — surface pump pressure, psi.
P_P — pore pressure, psi.
P_V — vertical mechanical force applied to a solid
Q — fluid flow rate, g.p.m.
R — drilling rate, ft./hr.
ρ — fluid density, lb./cu. ft.
σ — shear stress normal to plane of shear
σ_c — compressive strength of formation, lb.
t — octahedral shear stress in solids
t_y — shear stress at yield point
V_{AVG} — average flow stream velocity, ft. per second.
V_N — velocity of flow through bit nozzles, ft./min.
V_y — velocity of flow at y, ft. per second
W — weight on bit, thousand pounds
Z — force per unit of area to cause failure in surface of shear
1714 — units conversion constant

LABORATORY drilling rig. Fig. 32.

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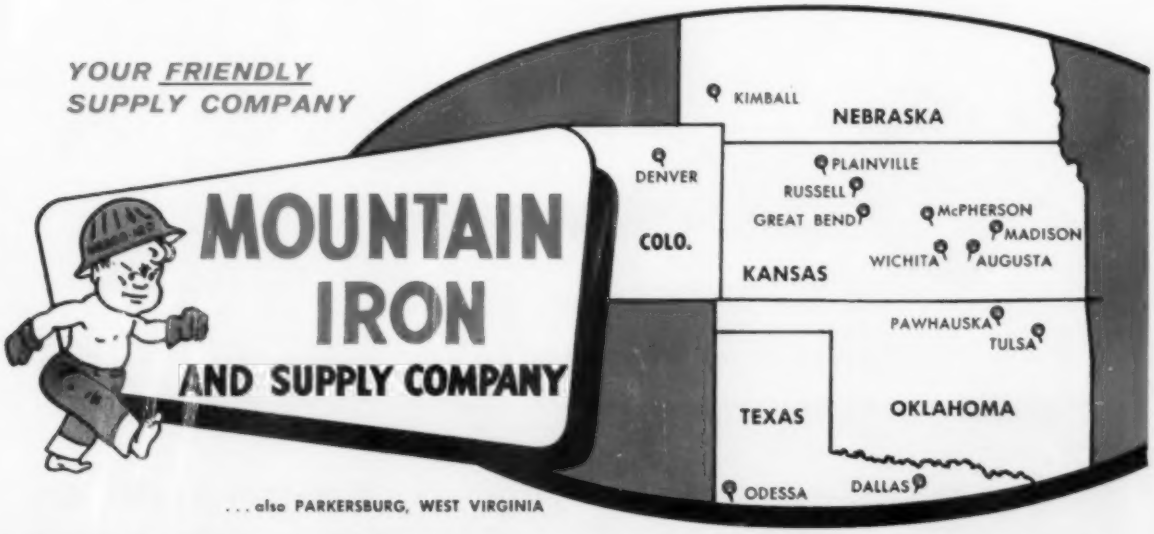

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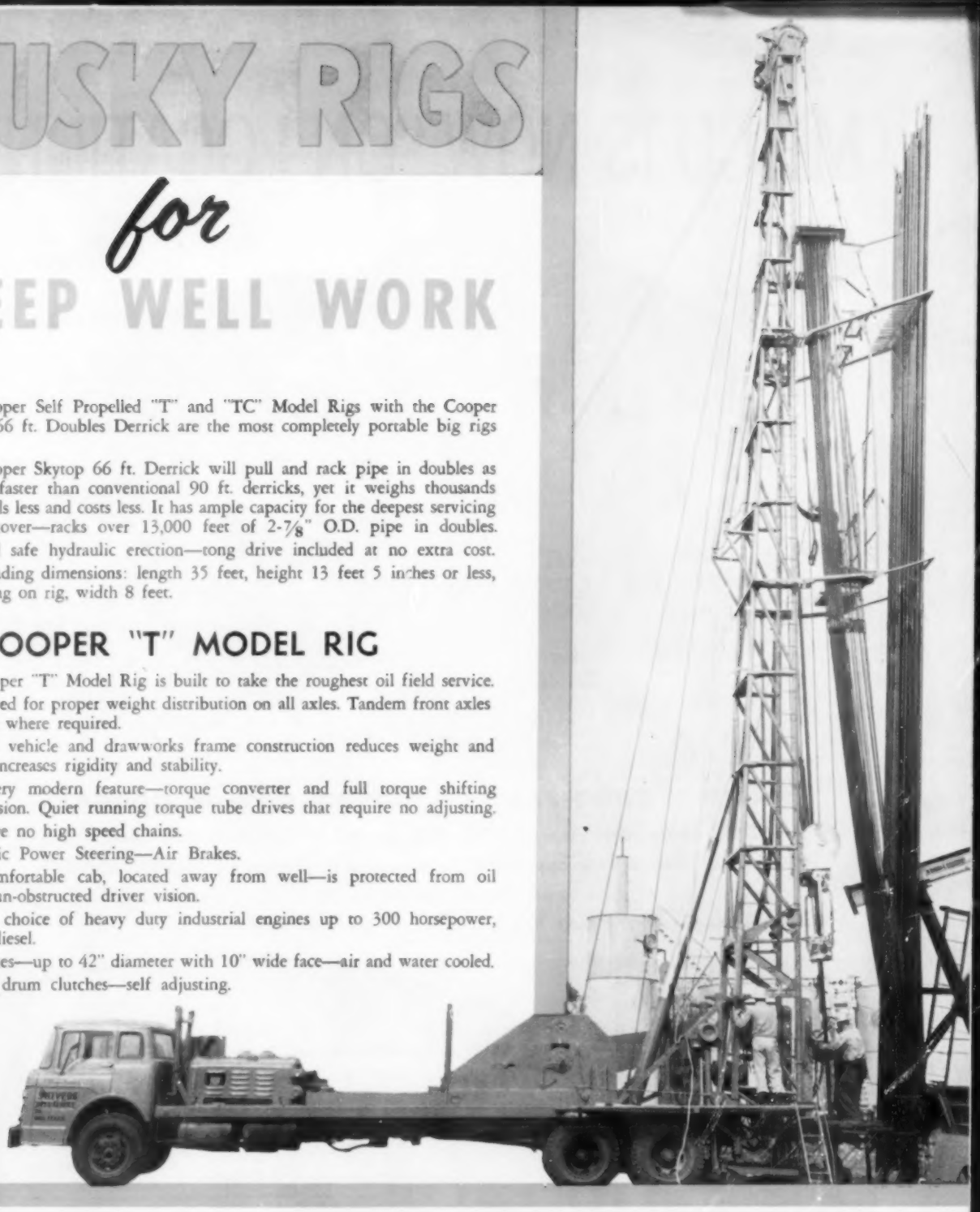

Cooper "T" Model Single Drum Workover Rig with Cooper Skytop Doubles Derrick on a deep workover job located on the Gulf Coast.

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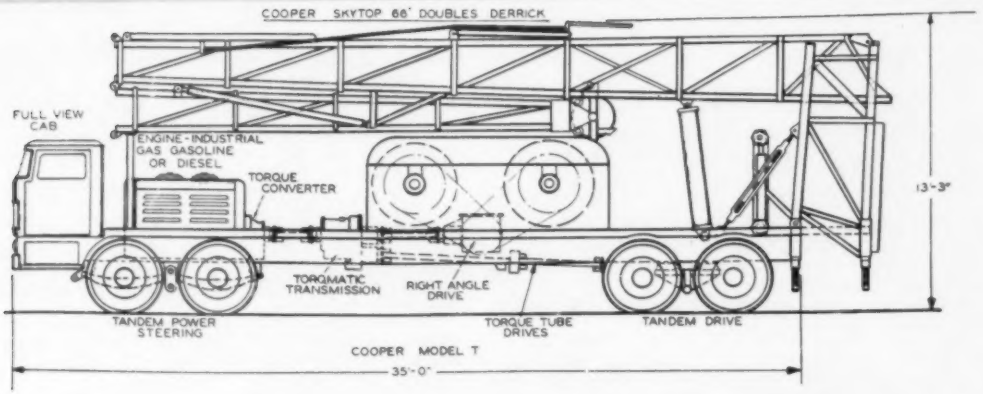

Cooper "T" Model Double Drum with Tandem front axles and Cooper Skytop Doubles Derrick in roading position.

COOPER TC MODEL DOUBLE DRUM WITH Cooper Skytop DOUBLES DERRICK

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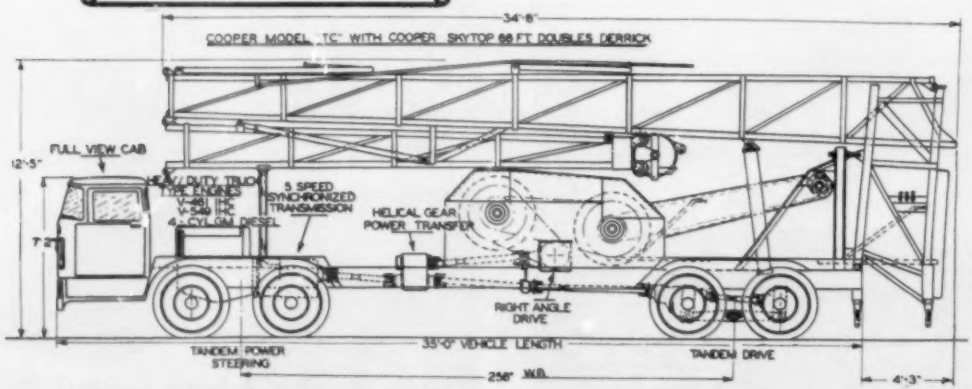

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Acknowledgment

The writer thanks Humble Oil & Refining Co. for permission to use certain parts of company information heretofore not published and also thanks the following individuals for their help, assistance, and criticism in the organization and compilation of the enclosed information.

C. V. Kirkpatrick, chairman of petroleum engineering school, University of Houston.

J. R. Eckel, W. E. Holland, and Dr. R. J. Blackwell, of Humble Oil & Refining Co.

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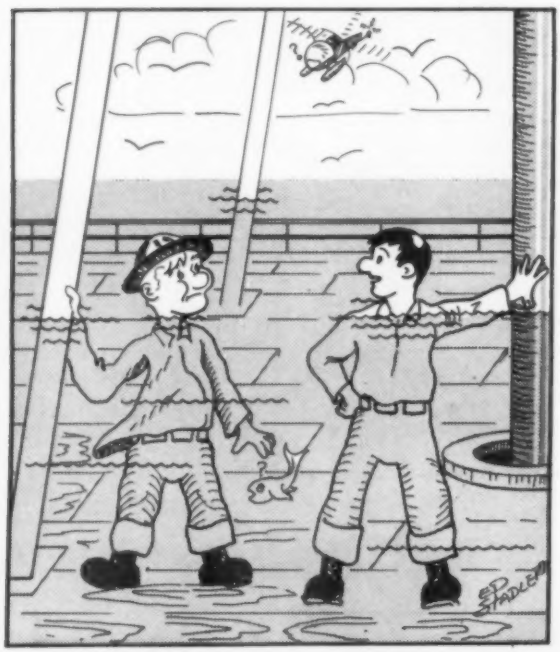

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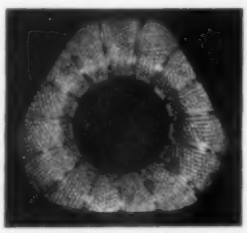

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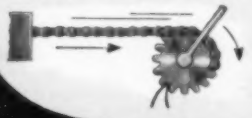

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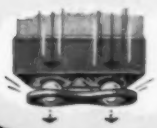

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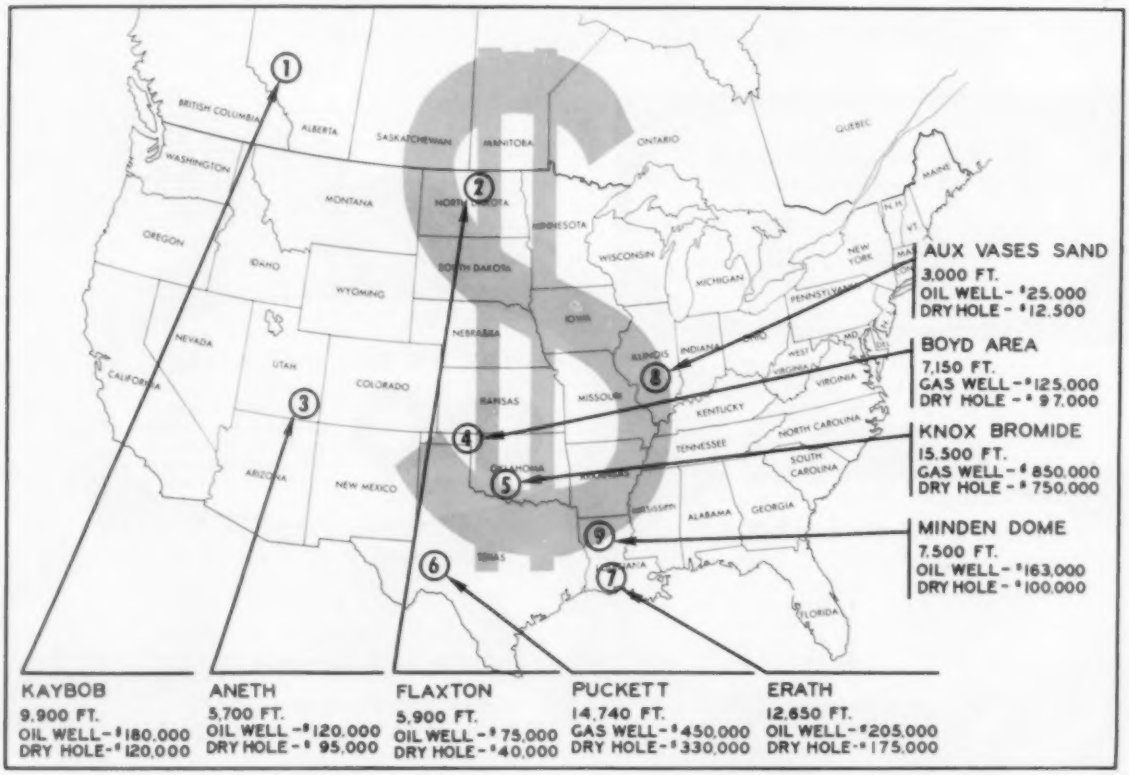


These producing areas make news as . . .

Active fields report drilling data

WHAT does a producing well cost?

Here The Oil and Gas Journal answers this question for 106 fields in the U. S. and Canada. The survey, for the first time, gives reliable information on actual costs of flowing and pumping wells and dry holes.

The data are for typical or average field wells and will be extremely valuable to both drilling contractors and operators alike. With this information, it is possible to estimate drilling and completion costs quite accurately and set up your casing and completion programs for a particular field. Of course, prior to drilling, any interested operator would check with drilling contractors, oil operators, and service companies for more detailed information.

Canada . . . Reef production at Leduc that spawned the present modern Canadian oil industry still attracts the oil operators. One of the most active areas at present is Innisfail in Alberta, where companies are exploiting the D-3 reef at 8,550 ft.

Another Canadian hot spot is Kaybob in Alberta. Here operators are completing 9,900-ft. Beaver Hill Lake oil wells with a price tag of $180,000.

The drilling surge in Saskatchewan has passed its peak, and many rigs have been shifted to other areas such as North Dakota. The relatively shallow drilling depth (4,200 ft.) and the lack of drilling problems, however, make this a popular spot. Completed wells at Glen Ewen and Carnduff cost in the neighborhood of $60,000.

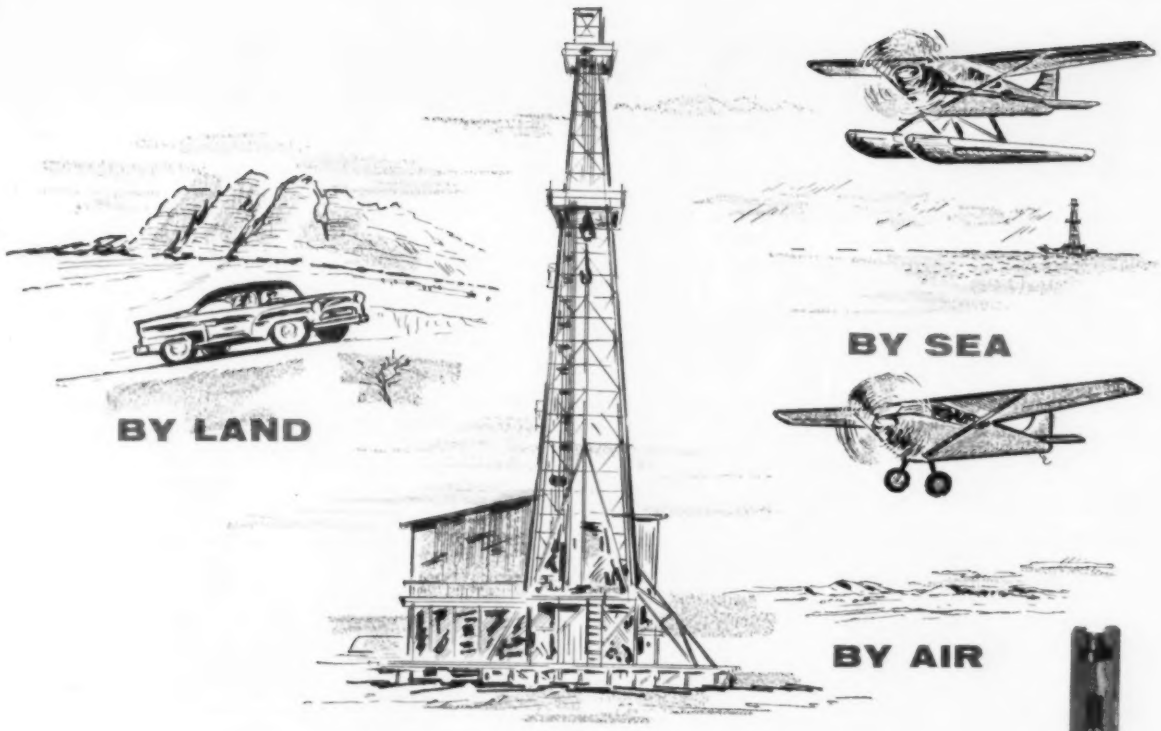
Rocky Mountains . . . The biggest concentration of drilling rigs in the Rocky Mountains is in the Four Corners area where operators are rapidly exploiting the Paradox pay zones at Aneth and Cretaceous oil sands in northwestern New Mexico. In the short period of 18 months, operators have cut costs appreciably in the Aneth area and now a 5,700-ft. flowing well is completed for $120,000.

BY NORMAN S. MORRISEY
Drilling-Development Editor

Mid-Continent . . . In Oklahoma, two important drilling plays dominate development activity: (1) deep Simpson production in southern Oklahoma; (2) gas sands in northwestern Oklahoma.

The price tag on deep Simpson producers is high with 10,300-ft. Bromide wells at Eola costing $285,000. But these cost figures are dwarfed by the gas-condensate wells at Knox Bromide where a typical producer runs $850,000 and a 15,500-ft. dry hole is a three-quarter of a million dollar writeoff.

Gas sands, principally in the Morrow section, have sparked an intense search throughout northwestern Oklahoma. Now with the promise of pipeline outlets, operators have entered the development stage in many of the fields. Gas wells in the Cherokee



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trend of Grant County, Oklahoma, run $45,000.

West Texas . . . Deep Devonian and Ellenburger reserves are important pay zones in West Texas, but in recent years, shallower pay zones have become commercial largely through the use of fracturing. As a result many old fields have witnessed a new drilling program outlining these reserves. Shallow sands in the Delaware basin, particularly in Culberson and Ward counties, have temporarily replaced the deeper pay zones. Here the Delaware sand is now an important reservoir and wells are completed for as little as $10 a foot.

South Louisiana . . . No area in the country today offers the operator a better drilling target than the Miocene sands of South Louisiana. However, the high cost of these wells and the hazardous drilling operations tend to keep out all but the more affluent independents and the major oil companies. With the trend toward deeper drilling, completed wells in South Louisiana run $15 to $20 a foot for wells in the 10,000 to 13,000-ft. bracket if no trouble is encountered.

This report includes timely drilling data about these fields . . .

Rocky Mountains

Colorado—Ignacio-Blanco, Tow Creek.
Montana—Cabin Creek.
Nebraska—Willson Ranch.
New Mexico—Blanco.
North Dakota—Beaver Lodge, Blue Buttes, Flaxton, Lignite.
Utah—Aneth, Red Wash.
Wyoming—Brooks Ranch, Cottonwood Creek, Desert Springs, Donkey Creek, Hamilton Dome, Little Buffalo basin.

Mid-Continent

Arkansas—Jerusalem, Sandy Bend, Stephens.
Illinois—Aux Vases production, Omaha.
Kansas—Greenwood, Hugoton, McKinney,, Skake Creek.
Oklahoma—Autwyne, Boyd Area, Camrick, Cherokee Trend, Cushing Area, Eola, Guthrie, Iron Post, Knox Bromide, LaVerne, Logan, Maysville, Mocane Area, Moore Area, Panhandle Gas, Payne, Red River, Ridgeway, Seminole Uplift, Sho-Vel-Tum, Skellyville Area, Wetumka Area.

Texas-New Mexico

New Mexico—Grayburg, Jalmat.
North Texas—Boonsville, Chico (West), East Bryson, Regular, Whitesboro.
South Texas—Mission River.
Texas Gulf Coast—Humble, Palacios, Red Fish Reef, Southwest Red Fish Reef, Theuvenins Creek.
Texas Panhandle—East Panhandle, Farnsworth, Hansford-Morrow, Perryton.
West Texas—Fuhrman-Mascho, Geraldine-Ford, Goldsmith, Hallanan, IAB, Jo Mill, McElroy, Puckett, Robertson, Sabre, Shafter Lake, Sonora, South Kermit. Twofreds, TXL Tubb.

Louisiana

North—Minden.
South—Bayou Choctaw, Black Bay, Erath, Jennings, Lake Arthur.

Canada

Alberta—Bellshill Lake, Cessford, Harmattan East, Innisfail, Kaybob, Keystone Area, Medicine Hat, Normandville, Olds, Pembina.
Saskatchewan—Carnduff, Glen Ewen, Steelman, Weyburn.

Note: In the following tabulations the footage figure shown in Pay is average TD. Under rig-time distribution, the total days figure is from spud to rig release.

Rocky Mountains

Colorado

IGNACIO-BLANCO, LaPlata County
Pay: Mesaverde, 5,600 ft.

Approx. cost of well. Dry hole $60,000. Flowing $90,000.

Cost averages: Footage price $4.50
Day: with pipe $750; without pipe $650

Normal Rig-Time Distribution

% on ft. rate	85	Total days	16
% on day rate	15	Total bits	16

Equipment
Fuel: Natural gas. Water: Trucks.
Supply center: Farmington, N. Mex.
Terrain, roads: Rough.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	200	200
Intermediate	7⅝	3,200	200
Oil string	5½	3,100-5,600	200

Typical Mud Program
Gel, water to intermediate, sacks 200
Gas to TD.

Avg. Formation Tops (Drlg. depth, ft.)
Mesaverde 4,900

TOW CREEK, Routt County
Pay: Niobrara shale, 3,400 ft.

Approx. cost of well: Dry hole $30,000
On pump $45,000

Cost averages (cable tool): Per foot $6
Day: with drill pipe $300

Normal Rig-Time Distribution

% on ft. rate	85	Total days	40
% on day rate	15		

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	13⅜	50	20
Oil string	5½	2,500-3,000	100

Note: Drill into production zone, plug back with lead wool and oakum, cement 5½ above zone, and produce open hole.

Avg. Formation Tops (Drlg. depth, ft.)
Mancos ..... Surface
Niobrara 2,000-3,000

Montana

CABIN CREEK, Wibaux County
Pay: Red River (Ordovician), 9,000 ft.

Cost averages: Footage price $6.00
Day: with pipe $1,150; without pipe, $1,050

Normal Rig-Time Distribution

% on ft. rate	95	Total days	35
% on day rate	5	Total bits	45

Equipment
Fuel: Gas.
Supply center: Glendive.
Terrain, roads: Rolling. Roads fair.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	1,000	350
Oil string	5½	TD	600

Avg. Formation Tops (Drlg. depth, ft.)

Greenhorn limestone	2,900
Dakota	3,800
Piper limestone	5,020
Charles "A" zone	6,800
Charles "B" zone	6,930
Mission Canyon	7,230
Silurian	8,400
Stone Mountain	8,750
Red River	8,900

Nebraska

WILLSON RANCH, Banner County
Pay: "J" sand, 5,365 ft.

Approx. cost of well: Dry hole $20,500
On pump $53,000

Cost averages: Footage price $2.25
Day: with pipe $670; without pipe $620

Normal Rig-Time Distribution

% on ft. rate	60	Total days	10
% on day rate	40	Total bits	4

Equipment
Fuel: Natural gas or LPG.
Water: Local ponds and shallow wells.
Supply center: Kimball.
Terrain, roads: Rolling hills. Gravel roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	9⅝	320	275
Oil string	5½	TD	150

Typical Mud Program

Bentonite, sacks	118
Phosphate, lb.	400
Quebracho, lb.	700
Caustic soda, lb.	720
Oil, bbl.	80

Avg. Formation Tops (Drlg. depth, ft.)

"D" sand	5,130
"J" sand	5,272

New Mexico

BLANCO, Rio Arriba County
Pay: Mesaverde, 5,500 ft.

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Approx. cost of well: Dry hole $48,000
Flowing $80,000

Cost averages: Footage price $5.25
Day: with pipe $725; without pipe $650

Normal Rig-Time Distribution

% on ft. rate	85	Total days	18-20
% on day rate	15	Total bits	15

Equipment

Fuel: Natural gas, diesel oil.
Water: Water holes, rivers.
Supply center: Farmington.
Terrain, roads: Rough. Dirt roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	150	150
Intermediate	7⅝	3,000	200
Oil string	3½	5,500	200

Typical Mud Program

Fresh water gel; weight; lost circulation.

Avg. Formation Tops (Drlg. depth, ft.)

Pictured Cliffs	2,600
Lewis	2,750
Cliff House	4,300
Point Lookout	4,900

Remarks: Wells are gas drilled from intermediate casing to total depth.

North Dakota

BEAVER LODGE, Williams County
Pay: Madison, 8,500 ft.

Approx. cost of well: Dry hole $59,000
Flowing $102,000 On pump $119,000

Cost average: Day rate with pipe $925
Drill-pipe rental is 1½ cents per foot.

Normal Rig-Time Distribution

% on ft. rate		Total days	26
% on day rate	100	Total bits	30

Equipment

Fuel: Butane. Water: Wells.
Supply center: Tioga.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	9⅝	619	350
Oil string	7	8,470	800

Typical Mud Program

Tannathin, sacks	18
Kembrake, sacks	42
Salt, sacks	1,519
Preservative, lb.	400
Mylogel, sacks	287
Hulls, sacks	35
Magcogel, sacks	56
Salt gel, sacks	15
Gypsum, sacks	20
Crude oil, bbl.	375

Avg. Formation Tops (Drlg. depth, ft.)

Greenhorn	3,827
Skull Creek	4,328
Dakota	4,579
Ellis	5,178
Spearfish	5,958
First Permian salt	6,258
Second Permian salt	6,417
Amsden	6,760
Kibbey limestone	7,465
Charles	7,616
Last salt	8,229
Madison	8,262
Pay	8,478

BLUE BUTTES, McKenzie County
Pay: Madison, 9,400 ft.

Approx. cost of well: Dry hole $91,000
Flowing $136,500 On pump $156,000

Cost average: Day rate with pipe $925
Drill-pipe rental is 1½ cents per foot.

Normal Rig-Time Distribution

% on ft. rate		Total days	32
% on day rate	100	Total bits	39

Equipment

Fuel: Butane. Water: Wells, ponds.
Supply center: Williston.
Terrain, roads: Level. Scoria roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	9⅝	620	450
Oil string	5½	9,350	1,200

Typical Mud Program

Saltgel, sacks	74
Magcogel, sacks	40
Hulls, sacks	28
Mica, sacks	80
Mylogel, sacks	286
Kembrake, sacks	21
Salt, sacks	2,000
Oil, bbl.	380

Avg. Formation Tops (Drlg. depth, ft.)

Greenhorn	4,162
Skull Creek	4,703
Dakota	4,950
Ellis	5,545
Spearfish	6,307
First Permian salt	6,621
Second Permian salt	6,924
Amsden	7,505
Kibbey limestone	8,145
Charles	8,288
Last salt	8,881
Madison	8,928
Pay	9,126

Utah

ANETH, San Juan County
Pay: Aneth Trend, 5,700 ft.

Approx. cost of well: Dry hole $95,000
Flowing $120,000 On pump $135,000

Cost averages: Footage price $9.00
Day: with pipe $900; without pipe $825

Normal Rig-Time Distribution

% on ft. rate	92	Total days	28
% on day rate	8	Total bits	35

Equipment

Fuel: Field gas. Water: San Juan River.
Supply center: Fifty miles.
Terrain, roads: Rough.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	1,200	700
Oil string	7	5,700	900

Typical Mud Program

Barites, lb.	5,000
Bentonites, lb.	10,000
Preservatives, lb.	1,500
Salt water gel, lb.	5,000
Starch, lb.	10,000

Avg. Formation Tops (Drlg. depth, ft.)

De Chelly	2,600
Organ Rock	2,700
Hermosa	4,520
Ismay	5,320
Paradox shale	5,455
Aneth	5,465
Chimney Rock	5,660
Salt	5,680

ANETH, San Juan County
Pay: Hermosa, 5,730 ft.

Approx. cost of well: Dry hole $60,000
Flowing $86,000 On pump $99,000

Cost averages: Footage price $5.50
Day: with pipe $950; without pipe $850

Normal Rig-Time Distribution

% on ft. rate	90	Total days	24
% on day rate	10	Total bits	35

Equipment

Fuel: Natural gas, butane/propane.
Water: Own well.
Supply center: Cortez, Colo. (60 miles).
Terrain, roads: Very rough.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	500 or 1,300	300 or 700
Oil string	5½	5,700	200

Note: Most wells to date are cemented through and perforated. Future wells will be barefoot.

Typical Mud Program

Bentonite, sacks	150
Caustic soda, lb.	600
Lignite, lb.	2,000

Avg. Formation Tops (Drlg. depth, ft.)

Hermosa	4,600
Paradox Member	5,600

RED WASH, Uintah County
Pay: Lower Green River, 5,800 ft.

Approx. cost of well: Dry hole $85,000
On pump $125,000

Normal Rig-Time Distribution

% on day rate	80	Total days	25
% on ft. rate	20	Total bits	30

Equipment

Fuel: Lease gas. Water: Lease system.
Supply centers: Vernal, Utah; Rangely, Colo.; Casper, Wyo.
Terrain, roads: Good.

Surface casing is 10¾; oil string, 7.

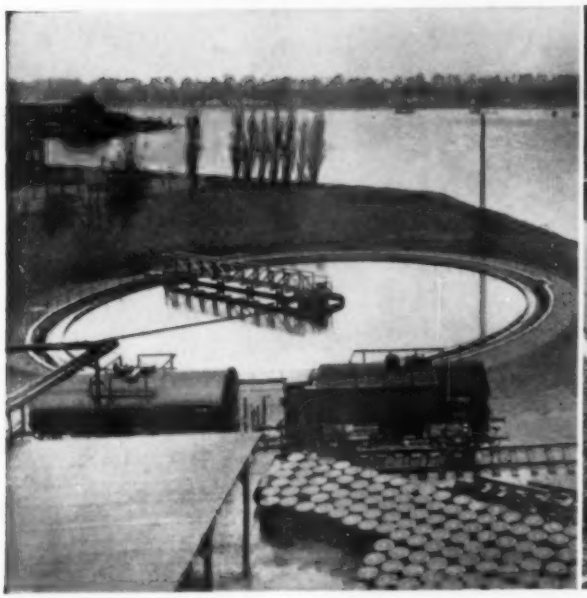
Mud program involves water to 3,000 ft., then light red mud to TD. Quantity varies with amount of lost circulation.

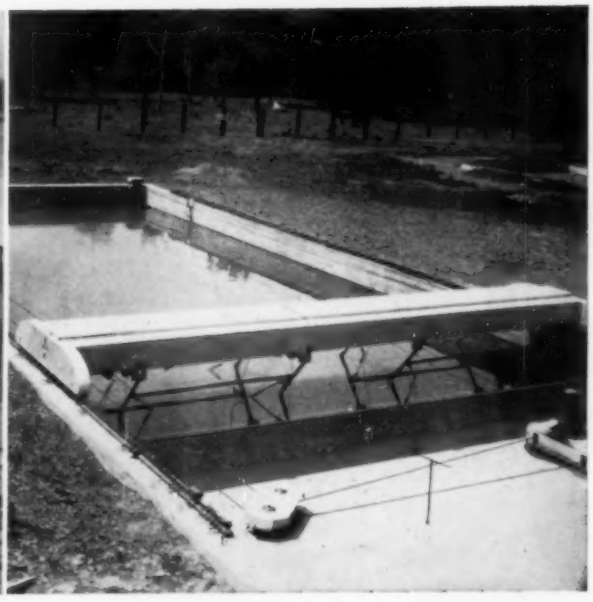
Green River formation top is at 3,000 ft.

Wyoming

BROOKS RANCH, Natrona and Converse Counties
Pay: Basal Frontier (3rd Frontier or 2nd Wall Creek), 4,200 ft.

round square rectangular





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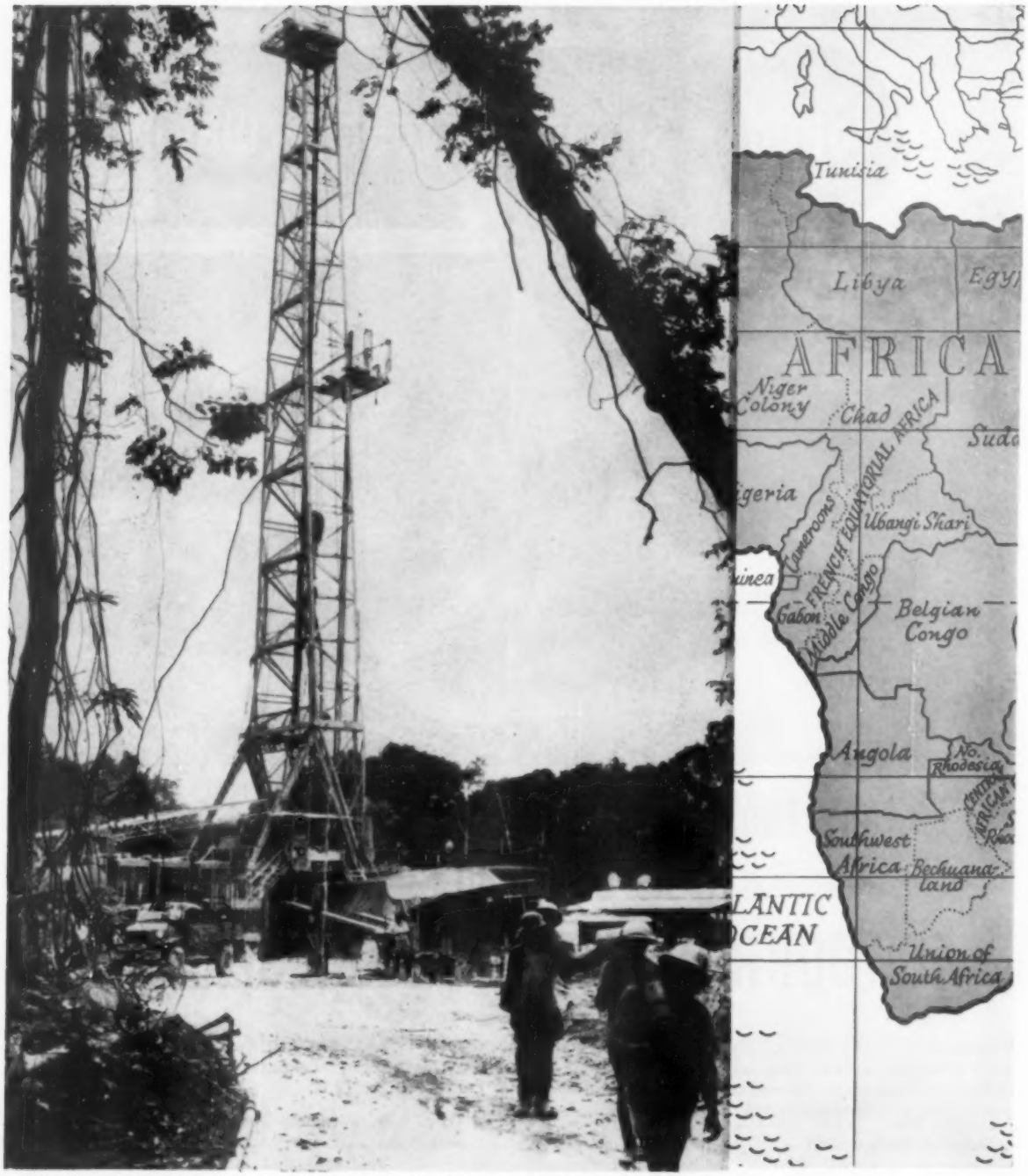

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Approx. cost of well: Dry hole $22,000 On pump $50,000

Cost averages: Footage price $3.25
Day: with pipe $750; without pipe $700

Normal Rig-Time Distribution

% on ft. rate	94	Total days	15
% on day rate	6	Total bits	12

Equipment

Fuel: Butane or diesel.
Water: Hauled from S. Platte River.
Supply center: Casper.
Terrain: Rolling topography; canyons.

FLAXTON, Burke County
Pay: Midale and Nesson (Madison), 5,900 ft.

Approx. cost of well: Dry hole $40,000 Flowing $75,000 On pump $90,000

Cost averages: Footage price $4.00
Day: with pipe $850; without pipe $825

Normal Rig-Time Distribution

% on ft. rate	88	Total days	18
% on day rate	12	Total bits	13

Equipment

Fuel: Butane. Water: City of Flaxton.
Supply center: Williston.
Terrain, roads: Flat. Dirt and gravel roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	500	380
Oil string	5½	5,900	350

Typical Mud Program

Gel, lb.	2,300
Salt gel, lb.	1,800
Gyp, lb.	2,000
Preservative, lb.	700
Impermix, lb.	4,450

Avg. Formation Tops (Drlg. depth, ft.)

Mississippian	5,450
"A" Porosity zone	5,500
Midale pay	5,800
Nesson pay	5,825
Nesson anhydrite	5,840

LIGNITE, Burke County
Pay: Midale, 6,300 ft.

Cost averages: Footage price $4.00
Day: with pipe $900; without pipe $825

Normal Rig-Time Distribution

% on ft. rate	80	Total days	18
% on day rate	20	Total bits	16

Equipment

Fuel: Diesel, gas, or butane.
Water: Hauled in.
Supply center: Tioga; Williston.
Terrain, roads: Flat. Rigs cannot move during spring thaw.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝		
	10¾	350	225
Oil string	5½	TD	300

Typical mud program cost averages $2,250.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	9⅝	120	75
Oil string	5½ or 4½	TD	125

Typical Mud Program

From surface to 500 ft. above Basal Frontier—water-native mud, adding gel as needed. Expect loss of circulation in top of Niobrara and in Second Frontier. Hulls and fiber are used for regaining loss of circulation if added volume and drilling ahead is not successful. Mud up above Basal Frontier with gel-phosphate-Ligco, adding lease crude for weight and water-loss control. Mud costs range from $600 to $2,200, depending on loss of circulation.

Avg. Formation Tops (Drlg. depth, ft.)

Steele shale	Surface
Niobrara shale	3,100
First Frontier sand	3,800
Second Frontier sand	3,900
Basal Frontier sand (pay)	4,200

Remarks: All wells are sandfractured on initial completion. Average initial potential pumping is 150-180 BOPD. Most completions are water free.

COTTONWOOD CREEK, Washakie County
Pay: Phosphoria, 9,180 ft.

Approx. cost of well: Dry hole $98,000 Flowing $161,500 On pump $179,000

Cost averages: Footage price $6.75
Day: with pipe $900*; without pipe $900
*Plus 2 cents for 4½ in. pipe; 1½ cents for 3½ in.

Normal Rig-Time Distribution

% on ft. rate	95.5	Total days	41
% on day rate	4.5	Total bits	42

Equipment

Fuel: Butane. Water: Field water wells.
Supply center: Worland.
Terrain, roads: Rough. Lease roads fair.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	9⅝	390	325
Oil string	7	9,180	300

Typical Mud Program

Caustic, lb.	7,350
Quebracho, lb.	2,400
Bicarb, lb.	18,400
Gel, sacks	215
Oil as needed	

Avg. Formation Tops (Drlg. depth, ft.)

Mesaverde	1,915
Frontier	5,760
Muddy	7,070
Chugwater	8,170
Phosphoria	9,080

DESERT SPRINGS, Sublette County
Pay: Lewis and Almond, 6,000 ft.

Approx. cost of well: Dry hole $60,000 Flowing $110,000

Cost averages: Footage price $7.00
Day: with pipe $900; without pipe $775

Normal Rig-Time Distribution

% on ft. rate	95	Total days	20-30
% on day rate	5	Total bits	20

Equipment

Fuel: Natural gas and diesel oil.
Water: Well.
Supply center: Rock Springs.
Terrain, roads: Level. Dirt roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	450	200
Oil string	5½	5,500-6,000	500

Typical Mud Program

Weight, lb.	10
Fresh water gel	

Avg. Formation Tops (Drlg. depth, ft.)

Lewis	5,000
Almond	5,400
Erickson	6,000

DONKEY CREEK, Crook County
Pay: Dakota, 6,250-6,270;
Cost averages: Footage price $3.10
Day: with pipe $960; without pipe $875

Total days (spud to rig release) 30

Equipment

Fuel: Natural gas. Water: Field wells.
Supply center: Newcastle.
Terrain, roads: Slightly rolling. Good roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	200	
Oil string	5½	6,300	300

Mud program includes gel, water, oil.

Dakota formation top is at 6,200 ft.

HAMILTON DOME, Hot Springs County
Pay: Tensleep, 3,200 ft.

Approx. cost of well: On pump $58,200

Cost averages: Footage price $6.50
Day: with pipe $650; without pipe $700

Normal Rig-Time Distribution

% on ft. rate	89	Total days	19
% on day rate	11	Total bits	20

Equipment

Fuel: Diesel or LPG.
Supply center: Thermopolis (25 miles).
Terrain, roads: Good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	100	100
Oil string	7	3,200	250

Typical Mud Program

Gel, lb.	23,500
Starch, lb.	5,000
Caustic, lb.	700
Lime, lb.	2,300
Viskal, lb.	550
Diesel, gal.	3,000

Avg. Formation Tops (Drlg. depth, ft.)

Chugwater	1,600
Embar	2,800
Tensleep	3,000

Remarks: Twenty-four-hour lost-circulation clause, 5° vertical—some areas are crooked-hole problems.

LITTLE BUFFALO BASIN, Park County
Pay: Embar and Tensleep (dually), 5,034 ft.

Approx. cost of well: Dry hole $67,600 Flowing $99,250 On pump $134,250

Cost averages: Footage price $7.75
Day: with pipe $750*; without pipe $750

*Plus 2c per ft. for 4½ in. pipe; 1½c per ft. for 3½ in. pipe.

Normal	Rig-Time	Distribution	
% on ft. rate	96	Total days	34
% on day rate	4	Total bits	41

Equipment
Fuel: Butane. Water: Field water.
Supply center: Worland.
Terrain, roads: Hilly. Good lease roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	250	250
Oil strings*	7	5,032	200-450

*Two-stage oil string.

Typical Mud Program

Gel, sacks	550
Lost circulation material, sacks	200
Brozin, lb.	3,000
Tannathin, lb.	4,500
Caustic, lb.	3,300
Crude oil, bbl.	200

Avg. Formation Tops (Drlg. depth, ft.)

Frontier	1,260
Muddy	2,425
Red Beds	3,685
Embar	4,680
Tensleep	4,844

Remarks: Lost circulation encountered at 1,700 ft. and 5,000 ft.

Mid-Continent

Arkansas

JERUSALEM, Conway County
Pay: Allen and Barton, 2,573 ft.

Approx. cost of well: Dry hole $49,600. Flowing $80,900.

Cost averages: Footage price $10.25
Day rate $335

Normal	Rig-Time	Distribution	
% on ft. rate	666	Total days	56
% on day rate	34	Total bits	28

Equipment
Fuel: LPG. Water: Local ponds, creeks.
Supply center: Seminole, Okla.
Terrain, roads: Rough.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	400	200
Oil string	5½	2,190	300

Typical Mud Program

Gel, sacks	270
Weight material, sacks	6
Caustic soda, lb.	2,000
Tannex, lb.	1,000

Avg. Formation Tops (Drlg. depth, ft.)

Allen	1,475
Barton	2,035

SANDY BEND, Union County
Pay: Nacotoch, 2,397 ft.

Approx. cost of well: Dry hole $6,201
On pump $16,976

Cost averages: Footage price $1.92
Hourly price $17.50

Normal	Rig-Time	Distribution	
% on ft. rate	97	Total days	4½
% on hr. rate	3	Total bits	1

Equipment
Fuel: Electricity. Water: Creeks.
Supply center: Twenty-eight miles.
Terrain, roads: Rolling hills. Dirt roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	71	60
Oil string	4½	2,393	80

STEPHENS, Columbia County
Pay: Buckrange, 2,150 ft.

Approx. cost of well: Dry hole $5,000
On pump $17,000

Cost averages: Footage price $1.75
Day: with pipe $480; without pipe $430

Normal	Rig-Time	Distribution	
% on ft. rate	95	Total days	3
% on day rate	5	Total bits	2

Equipment
Fuel is butane.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	65	50
Oil string	4½	2,150	150

Illinois

AUX VASES PRODUCTION, Hamilton County
Pay: Aux Vases sandstone, 3,200 ft.

Approx. cost of well: Dry hole $12,000
On pump $42,000

Cost averages: Footage price $3.20
Hourly rate $17.50

Normal	Rig-Time	Distribution	
% on ft. rate	92	Total days	6
% on hr. rate	8	Total bits	11

Equipment
Fuel: Diesel. Water: Farm ponds.
Supply center: Mt. Vernon.
Terrain, roads: Hilly. Gravel roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	30-75	40-100
Oil string	5½	3,200	150

Typical Mud Program
Bentonite, caustic, Quebracho—100 sacks.

Avg. Formation Tops (Drlg. depth, ft.)

Cypress	2,850
Aux Vases sandstone	3,150

AUX VASES PRODUCTION, White County
Pay: Aux Vases sand, 3,020 ft.

Approx. cost of well: Dry hole $12,500
On pump $25,000

Cost averages: Footage price $3.50
Hourly rate $17.50

Normal	Rig-Time	Distribution	
% on ft. rate	90	Total days	7-10
% on hr. rate	10	Total bits	12-20

Equipment
Fuel: Diesel or butane.
Water: Ponds, creeks, rivers.
Supply centers: Cressville, Carmi.
Terrain: Flat to rolling.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	65-120	60
Oil string	5½-7	3,020	100

Note: Most operators set pipe through Aux Vases and perforate due to high initial gas-oil ratio.

Typical Mud Program

Aquagel or Magcogel, sacks	60
Quebracho, lb.	200
Caustic soda, lb.	200

Avg. Formation Tops (Drlg. depth, ft.)

Glenn Dean limestone	2,450
Barlow limestone	2,650
Cypress sandstone	2,700
Renault limestone	2,880
Aux Vases sandstone	2,950

OMAHA, Gallatin County
Pay: Aux Vases, Tar Springs, and Palestine, 2,700 ft.

Approx. cost of well: Dry hole $15,000
On pump $35,000

Cost averages: Footage price $3.50
Hourly rate $17.50

Normal	Rig-Time	Distribution	
% on ft. rate	90	Total days	10
% on hr. rate	10	Total bits	*16

*Includes 10 retips.

Equipment
Fuel: Diesel. Water: River.
Supply center: Ridgway (6 miles).
Terrain, roads: River bottoms low and muddy. Expensive cat and truck bills.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	80	100
Oil string	5½	2,700	300

Typical Mud Program

Baroid mud, bags	200
Tannex, lb.	200
Soda ash, lb.	200
Caustic soda, lb.	100

Avg. Formation Tops (Drlg. depth, ft.)

Aux Vases	2,675
Tar Springs	1,950
Palestine	1,700
Penn	550

Kansas

GREENWOOD, Morton County
Pay: Topeka, 3,183 ft.

Approx. cost of well: Flowing $7,648

Cost averages: Footage price $2.40
Hourly: with pipe $20; without pipe $13

Normal	Rig-Time	Distribution	
% on ft. rate	98	Total days	8½
% on hr. rate	2	Total bits	8

Equipment
Fuel, water furnished by contractor.

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Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Intermediate	7	700	200
Oil string	4½	3,120	100

Typical Mud Program

Mud material, sacks	236
Chemical material, sacks	20
Loss circulation material, sacks	300

Avg. Formation Tops (Drlg. depth, ft.)

Wabaunsee	2,650
Topeka	2,850
Greenwood Lansing	3,000

Remarks: Figure on approximate cost of producer is contractor cost only, as the complete cost of well is unavailable.

HUGOTON (gas), Finney County
Pay: Chase Group, 2,650 ft.

Approx. cost of well: Dry hole $14,000. Flowing $28,000.

Cost averages: Footage price $2.50
Hourly: with pipe $20; without pipe $13

Normal	Rig-Time	Distribution	
% on ft. rate	95	Total days	5
% on hr. rate	5	Total bits	5

Equipment

Fuel: Diesel.
Water: Hauled from ponds or wells.
Supply center: Liberal (90 miles).
Terrain, roads: Level. Unimproved roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	300	200
Oil string	5½	2,650	200

Typical Mud Program

Gel, sacks	40
Salt gel, sacks	40

McKINNEY, Clark County
Pay: Mississippian, primarily; Morrow sand occasionally, 6,000 ft.

Approx. cost of well: Flowing $65,000.

Cost averages: Footage price $4.25
Day: with pipe $650; without pipe $550

Normal	Rig-Time	Distribution	
% on ft. rate	100	Total days	24
% on day rate		Total bits	23

Equipment

Fuel: N-gas or butane. Water: Wells.
Supply center: Laverne (30 miles).
Terrain, roads: Slightly hilly. Roads good to fair all weather.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Intermediate	8⅝	1,200	600
Oil string	4½	TD	200

Note: Cement on intermediate is circulated to surface.

Typical Mud Program

Bentonite, sacks	50
Salt gel, sacks	200
Starch, sacks	130
Preservative, sacks	8
Lost-circulation material, sacks	90
Oil, bbl.	300

Remarks: Lost-circulation zones at 250-400 ft. and 4,200-4,400 ft. Some companies have had serious difficulty with lost circulation at 400 ft. However, of 13 wells drilled, lost circulation has not been a major problem.

SKAKE CREEK, Clark County
Pay: Cherokee sand, 5,600 ft.

Approx. cost of well: Dry hole $54,000
Flowing $73,000. On pump $77,500

Cost averages: Footage price $5.50
Hourly: with pipe $27; without pipe $25

Normal	Rig-Time	Distribution	
% on ft. rate	81	Total days	26
% on hr. rate	19	Total bits	20

Equipment

Fuel: Diesel. Water: Well.
Supply center: Twenty miles.
Terrain, roads: Good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	13⅜	575	500
Intermediate	8⅝	1,600	750
Oil string	5½	5,600	150

Typical Mud Program

Starch, sacks	180
Gel, sacks	225
Salt water gel, sacks	340
Preservative, lb.	700
Lime, sacks	15
Hulls, sacks	67
Oil, bbl.	70

Avg. Formation Tops (Drlg. depth, ft.)

Heebner	4,280
Lansing-Kansas City	4,480
Cherokee	5,400
Mississippi	5,550

Remarks: Biggest problem is drilling surface hole because of caverns, etc., in first 1,500 ft.

Oklahoma

AUTWYNE (26n-1e), Kay County
Pay: Skinner sand, 4,000 ft.

Approx. cost of well: Dry hole $24,750. Flowing $32,222.

Cost averages: Footage price $3.25
Day: with or without pipe $550

Normal	Rig-Time	Distribution	
% on ft. rate	95	Total days	15
% on day rate	5	Total bits	16

Equipment

Fuel: Propane. Water: Pond.
Supply center: Six miles.
Terrain, roads: Level pasture. Good roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	100	160
Oil string	5½	3,882	64

Typical Mud Program

Aquagel, sacks	261
Cotton seed hulls, sacks	12
Soda ash, sacks	11
Caustic soda, sacks	9
Myratan, sacks	16
Lime, sacks	2

Avg. Formation Tops (Drlg. depth, ft.)

Osage Layton sand	3,035
Checkerboard lime	3,379
Big lime	3,628
Skinner sand	3,788
Red Fork sand	3,920

BOYD AREA (2n-21ecm), Beaver County
Pay: Morrow, 7,150 ft.

Approx. cost of well: Flowing $125,000

Cost averages: Footage price $4.70
Day: with pipe $800; without pipe $700

Normal	Rig-Time	Distribution	
% on ft. rate	100	Total days	28
% on day rate		Total bits	27

Equipment

Fuel: Butane. Water: Well.
Supply center: Perryton, Tex.
Terrain: Flat plains.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	11¾	500	250
Intermediate	8⅝	2,800	250
Oil string	5½	7,150	125

Typical Mud Program

Gel, tons	34
Salt gel, tons	5
Emulsifier, lb.	13
Soda ash, lb.	3,400
Diesel oil (per cent)	12

Avg. Formation Tops (Drlg. depth, ft.)

Pennsylvanian	3,948
Lansing-Kansas City	5,100
Marmaton	6,123
Cherokee	6,482
Morrow	6,958

CAMRICK, Beaver County
Pay: Purdy sand, 7,500 ft.

Approx. cost of well: Dry hole* $97,000
*Pipe set.

Cost averages: Footage price $5.25
Day: with pipe $800; without pipe $750

Normal	Rig-Time	Distribution	
% on ft. rate	87.5	Total days	28
% on day rate	12.5		

Equipment

Fuel: Gas.
Supply center: Two miles.
Terrain, roads: Fair.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	13⅜	495	
Intermediate	9⅝	2,963	
Oil string	5½	7,617	

Typical mud bill averages $8,100.

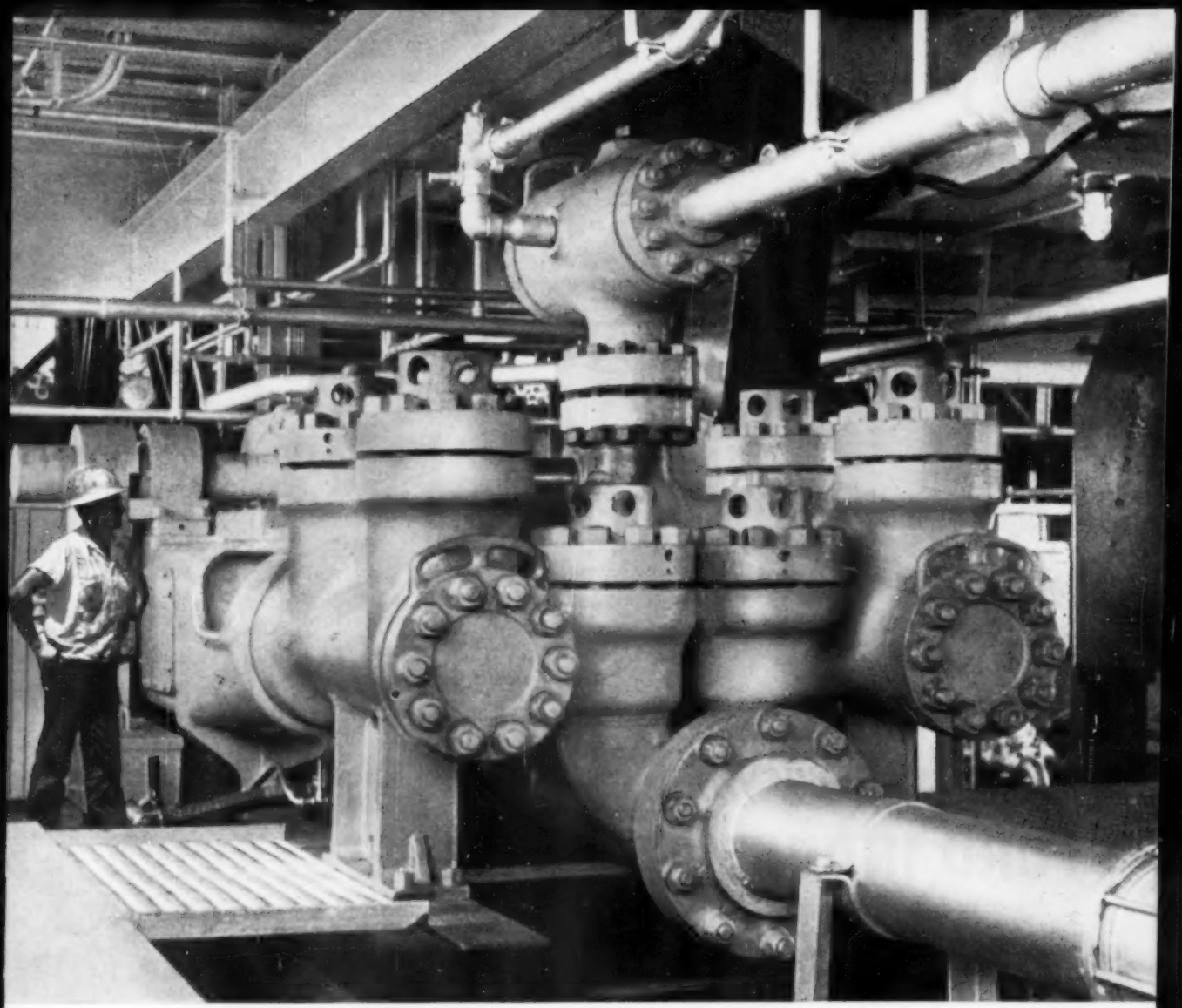
Avg. Formation Tops (Drlg. depth, ft.)

Toronto lime	5,024
Checkerboard lime	5,748
Purdy sand	7,192

CHEROKEE TREND, Alfalfa County
Pay: Basal Pennsylvanian, 5,300 ft.

Approx. cost of well: Dry hole $23,700
Flowing $46,200 On pump $39,400

Cost averages: Footage price $3.00
Day: with pipe $675; without pipe $600



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G-65	8 x 16	650	2460 lb
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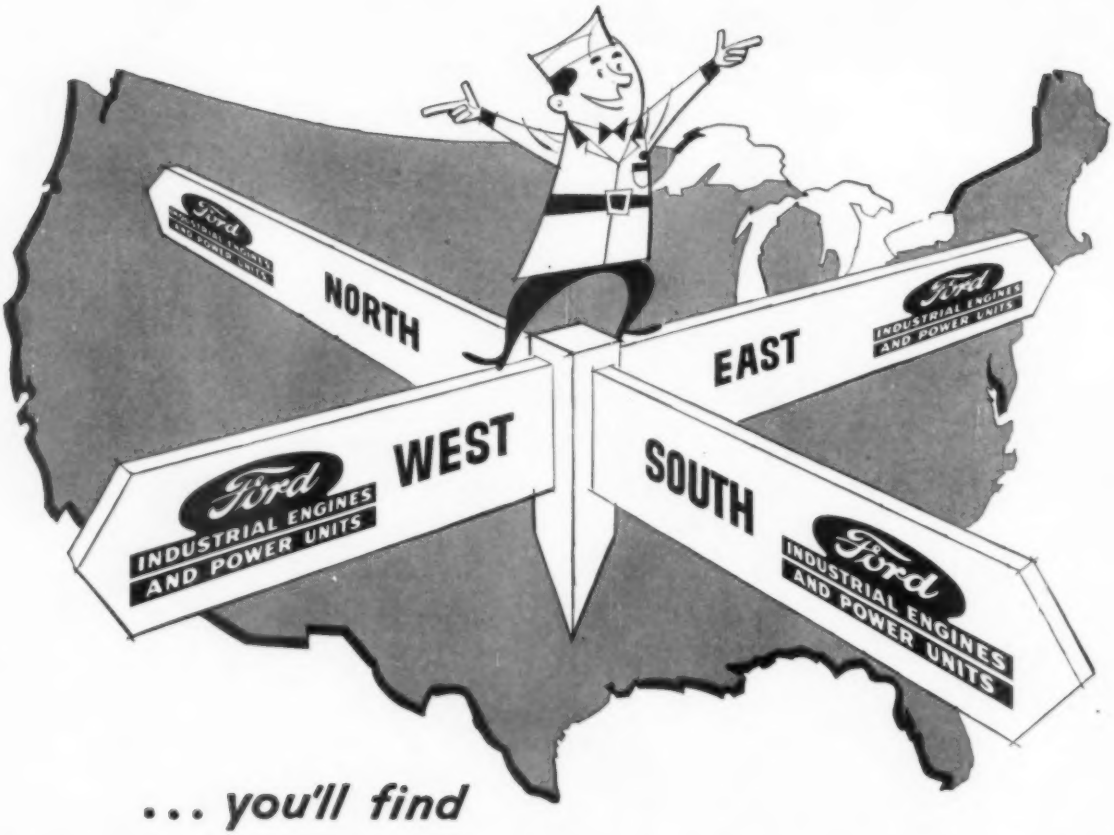

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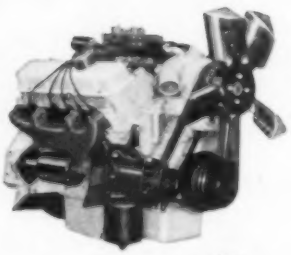

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ACTIVE FIELDS

Normal	Rig-Time	Distribution	
% on ft. rate	80	Total days	20
% on day rate	20	Total bits	14

Equipment
Fuel: Butane. Water: Pond or well.
Supply center: Cherokee.
Terrain, roads: Fair.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	358	200
Oil string	4½	5,170	150

Avg. Formation Tops (Drlg. depth, ft.)

Tonkawa	4,142
Layton	4,535
Basal Pennsylvanian	5,135
BP/Mississippian	5,181

CHEROKEE TREND, Grant County
Pay: Cherokee, 4,880 to 4,910 ft.

Approx. cost of well: Dry hole $21,000. Flowing $45,000.

Cost averages: Footage price $3.00
Day: with pipe $585; without pipe $525

Normal	Rig-Time	Distribution	
% on ft. rate	92	Total days	20-24
% on day rate	8	Total bits	17

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	264	175
Oil string	5½	4,862	125

Typical Mud Program

Magcogel, sacks	50
Salt gel, sacks	252
High Yield, sacks	144
My-Lo-Jel, lb.	2,450
Preservative, lb.	100
Hulls, sacks	38
Lime, sacks	1

Note: Mud bill averages $1,645.

Avg. Formation Tops (Drlg. depth, ft.)

Tonkawa	3,675
Layton	4,098
Hogshooter lime	4,214
Checkerboard lime	4,293
Big lime—Oswego	4,451
Cherokee sand	4,765
Detrital zone	4,844
Mississippian lime zone	4,880

CUSHING AREA, Creek County
Pay: Red Fork, 2,700 ft.

Approx. cost of well: Dry hole $9,000 Flowing $13,000. On pump $21,000

Cost averages: Footage price $2.50
Hourly: with pipe $20; without pipe $15

Normal	Rig-Time	Distribution	
% on ft. rate	95	Total days	8
% on hr. rate	5	Total bits	9

Equipment
Fuel: Butane. Water: Ponds.
Supply center: Cushing.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8	100	100
Oil string	5½	2,700	50

Avg. Formation Tops (Drlg. depth, ft.)

Cleveland	2,000
Prue	2,400
Skinner	2,550
Red Fork	2,650
Bartlesville	2,800

EOLA, Garvin County
Pay: (Duals) Bromide, Oil Creek, McLish, or Hunton, 10,300 ft.

Approx. cost of well: Dry hole $175,000 Flowing $285,000.

Cost averages: Day with pipe $1,040 Day without pipe $875

Normal	Rig-Time	Distribution	
% on day rate	100	Total days	125
		Total bits	126

Equipment
Fuel: Natural gas and/or butane.
Water: Shallow wells.
Supply center: Pauls Valley.
Terrain, roads: Rolling hills. Roads are blacktopped highways.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	13⅜	1,550	1,050
Oil string	7	10,300	1,080

Typical Mud Program

Bentonite gel, tons	90.2
Barite, tons	122.2
Caustathin, bags	591
Caustic soda, cans	45
Soda ash, bags	5

Avg. Formation Tops (Drlg. depth, ft.)

Bromide	8,315
McLish lime	8,947
Oil Creek	9,526
B. Oil Creek sand	10,063

GUTHRIE, Logan County
Pay: Layton, 4,600 ft.; Cleveland, 4,850 ft.

Approx. cost of well: Flowing $48,000
Cost averages: Footage price $3.00
Day: with pipe $650; without pipe $600

Normal	Rig-Time	Distribution	
% on ft. rate	98	Total days	16
% on day rate	2	Total bits	16

Equipment
Fuel: Gas. Water: Pond.
Supply center: Oklahoma City.
Terrain, roads: Fair.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	250	200
Oil string	5½	4,850	100-200

Avg. Formation Tops (Drlg. depth, ft.)

Layton sand zone	4,510
Cleveland sand zone	4,800

IRON POST, Creek County
Pay: Cleveland, 1,600 ft.

Cost averages: Footage price $2.00
Day: with pipe $500; without pipe $450

Total rig time, days: 4. Total bits: 4.

Equipment
Fuel: Butane. Water: Creeks.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8	100	
Oil string	4	1,600	

KNOX BROMIDE, Grady County
Pay: Second and third Bromide sands, 15,500 ft.

Approx. cost of well: Dry hole $750,000. Flowing $850,000.

Cost averages: Footage price $14
Day: with pipe $1,390; without pipe $1,140

Normal	Rig-Time	Distribution	
% on ft. rate	33	Total days	195
% on day rate	67	Total bits	165

Equipment
Fuel: Gas. Water: Well.
Supply centers: Duncan, Lindsay.
Terrain, roads: Good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	13⅜	3,650	2,800
Intermediate	9⅝	9,200	2,775
Oil string	7	14,800	1,200

Typical Mud Program

Barite, sacks	26,400
Bentonite, sacks	2,270
Lignite, sacks	1,280
Quebracho, sacks	344
Lost-circulation material, sacks	3,927

Avg. Formation Tops (Drlg. depth, ft.)

Sycamore	12,920
Hunton	13,370
Second Bromide	14,900
Third Bromide	15,120

LAVERNE AREA, Harper County
Pay: Hoover, Tonkawa, Chester, Morrow, 7,300 to 7,600 ft.

Approx. cost of well: Flowing $95,000

Cost averages: Footage price $5.00
Day: with pipe $850; without pipe $750

Normal	Rig-Time	Distribution	
% on ft. rate	85	Total days	25-28
% on day rate	15	Total bits	21-23

Equipment
Fuel: Gas. Water: Wells.
Supply center: One mile.
Terrain, roads: Fair.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	13⅜	500	500
Intermediate	8⅝-9⅝	3,000	250
Oil string	5½-7	7,300-7,600	150

Typical Mud Program
Gel and lost-circulation material.
Cost averages $2,500 to $4,000.

Avg. Formation Tops (Drlg. depth, ft.)

Tonkawa	5,400
Hoover	4,100
Morrow	6,900
Chester	7,100

LOGAN AREA, Beaver County
Pay: Lower Tonkawa, 6,101 ft.

Approx. cost of well: Dry hole $61,659 Flowing 102,457. On pump $118,152

DIAMETRICAL WEAR X .001 INCHES
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COMPARISON OF WEAR RESISTANCE
REVOLUTIONS X 1,000,000

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three years field proven . . . there is nothing newer!

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1. *Inarclad uses the high-alloy steel of the tool joint itself as the binder for the hard metal.*
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3. *The steel of the tool joint will not become oxidized by the heat of the weld because the arc is operating in an inert atmosphere.*
4. *Uniform amounts of hard metal are put into each band. More hard metal!*
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In the laboratory, as the chart to the left shows, exhaustive tests have proven Inarclad hard metal wears more than twice as long as other hard metal applications.

ACTIVE FIELDS

Normal Rig-Time Distribution

% on ft. rate	90	Total days	30
% on day rate	10	Total bits	23

Equipment

Fuel: Butane. Water: Nearby creek.
Supply center: Liberal, Kans.
Terrain, roads: Rolling. Good gravel roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	623	625
Oil string	5½	6,097	*150

*2 to 1 Stratacrete, 4% gel.

Typical Mud Program

Aquagel, sacks	98
Zeogel, sacks	748
Impermex, sacks	358
Preservative, sacks	17
Defoamer, sacks	2
Micatex, sacks	5
Fibertex, sacks	244
Jelflake, sacks	68
Hulls, sacks	51
Soda ash, sacks	22
Lime, sacks	3
DME, drums	2

Avg. Formation Tops (Drlg. depth, ft.)

Wabaunsee Group	4,331
Shawnee Group	4,715
Douglas Group Toronto	5,503
Tonkawa sand	5,982
Kansas City-Lansing	6,036

MAYSVILLE, Garvin County
Pay: Upper Bromide, 6,600 ft.

Approx. cost of well: Dry hole $50,000
Flowing $70,000. On pump $80,000

Cost averages: Footage price $4.00
Day: with pipe $650; without pipe $600

Normal Rig-Time Distribution

% on ft. rate	90	Total days	30
% on day rate	10	Total bits	30

Equipment

Fuel: Pipeline gas. Water: City.
Supply center: Fifteen miles.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	600	300
Oil string	7	6,600	250

Typical Mud Program

Gel, tons	54
Caustic, cans	28
Soda ash, bags	12
Driscose, bags	5

Avg. Formation Tops (Drlg. depth, ft.)

Unconformity sand	6,090
Viola	6,100
Upper Bromide sand	6,500
First Bromide sand	6,550

MOCANE AREA, Beaver County
Pay: Tonkawa, Morrow, Chester, Mississippian, 7,500 ft.

Approx. cost of well: Dry hole $85,000.
Flowing $125,000.

Cost averages: Footage price $5.25
Day: with pipe $700; without pipe $650

Normal Rig-Time Distribution

% on ft. rate	91.5	Total days	35
% on day rate	8.5	Total bits	30

Equipment

Fuel: Gas, LPG. Water: Well.
Supply center: Liberal, Kans.
Terrain, roads: Flat. Poor roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	13⅜	550	400
Intermediate	9⅝	2,800	500
Oil string	5½	7,500	500

Note: Circulate cement on surface pipe.

Typical Mud Program

Gel, lb.	90,000
Cabonex, lb.	5,000
Soda ash, lb.	5,000
Caustic soda, lb.	4,000
Lost-circulation material, lb.	40,000

Avg. Formation Tops (Drlg. depth, ft.)

Council Grove	3,400
Tonkawa	5,500
Checkerboard	6,000
Morrow	7,000
Chester Mississippian	7,400

MOORE AREA, Cleveland County
Pay: Hunton, 8,025 ft.

Approx. cost of well: Dry hole $50,000
Flowing $80,000. On pump $90,000

Cost averages: Footage price $4.25
Day: with pipe $700; without pipe $600

Normal Rig-Time Distribution

% on ft. rate	95	Total days	28
% on day rate	5	Total bits	28

Equipment

Fuel: Pipeline gas.
Supply center: Ten miles.
Terrain, roads: Good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	900	600
Oil string	7	8,025	300

Typical Mud Program

Caustic, cans	12
Soda ash, bags	26
Fiber, bags	11
Gel, tons	27

Avg. Formation Tops (Drlg. depth, ft.)

Prue sand	7,324
Red Fork sand	7,620
Bartlesville sand	7,680
Woodford shale	7,800
Hunton lime	7,900

PANHANDLE GAS, Texas County
Pay: Morrow, 6,800 ft.

Approx. cost of well: Dry hole $60,000
Flowing $110,000.

Cost averages: Footage price $4.50
Day: with pipe $750; without pipe $700

Normal Rig-Time Distribution

% on ft. rate	90	Total days	23
% on day rate	10	Total bits	27

Fuel: Natural gas. Water: Wells.
Supply center: One-half mile.
Terrain, roads: Flat, sandy. Dirt roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	2,900	*1,000
Oil string	5½	6,700	†150-300

*2% gel. †4% gel.

Typical Mud Program

Includes gel, quebracho, soda ash, hulls, salt gel and My-Lo-Jel. Mud program cost is approximately $4,135.

Avg. Formation Tops (Drlg. depth, ft.)

Toronto	4,264
Cherokee	5,626
Morrow	6,100
Mississippi (Chester)	6,635

PANHANDLE GAS, Texas County
Pay: Krider, 2,550 ft.

Approx. cost of well: Flowing $6,257.

Cost averages: Footage price $2.45
Day: with pipe $550; without pipe $500

Normal Rig-Time Distribution

% on ft. rate	98	Total days	5
% on day rate	2	Total bits	6

Equipment

Fuel, water furnished by contractor.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Intermediate	7	450	250
Oil string	4½	2,540	100

Typical Mud Program

Mud material, sacks	170
Chemical material, sacks	25
Lost-circulation material, sacks	85

Remarks: Figure on approximate cost of well is contractor cost only, as the complete cost of well is unavailable.

PAYNE, McClain County
Pay: Hunton and/or Bromide, 8,500 to 9,500 ft.

Approx. cost of well:
Flowing $85,000 to $150,000.

Cost averages: Footage price $4.90
Day: with pipe $915; without pipe $800

Normal Rig-Time Distribution

% on ft. rate	85	Total days	32-42
% on day rate	15	Total bits	45-50

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	600	600
Oil string	5½-7	8,500-9,500	150

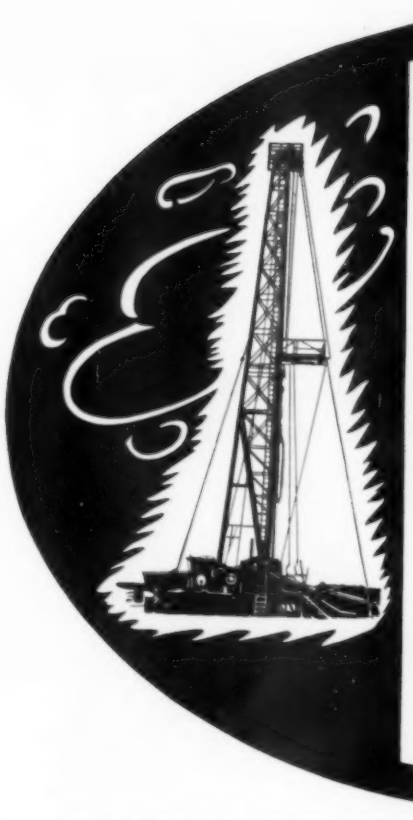
Typical Mud Program

Gel, caustic soda, and soda ash. Cost averages $2,500 to $4,000.

Avg. Formation Tops (Drlg. depth, ft.)

Hart	7,800
Hunton	8,300
Viola	8,600
First Bromide	9,150

RED RIVER (5s-14w), Tillman County
Pay: Gunsite sands, 1,600-1,700 ft.



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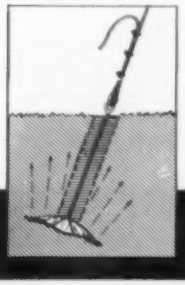
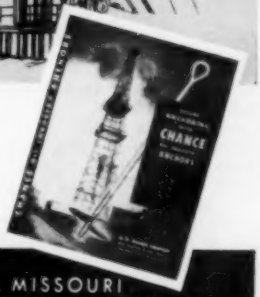


Load evenly distributed over a wide area due to square pyramid shape.



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TORONTO, ONTARIO, CANADA

ACTIVE FIELDS

Approx. cost of well: Dry hole $6,000; On pump $15,000

Cost averages: Footage price $1.65
Hourly: with pipe $20; without pipe $15

Normal Rig-Time Distribution			
% on ft. rate	50	Total days	4
% on hr. rate	50	Total bits	1-2

Equipment
Fuel: Butane. Water: River.
Supply center: Burkburnett.
Terrain, roads: Poor.

RIDGEWAY (3n-25ecm), Beaver County
Pay: Tonkawa sand, 7,600 ft.

Approx. cost of well: Flowing $112,000

Cost averages: Footage price $4.70
Day: with or without pipe $750

Normal Rig-Time Distribution			
% on ft. rate	84	Total days	37
% on day rate	16	Total bits	36

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	465	300
Oil string	5½	7,525	150

Typical Mud Program

H. Visgel, tons	29
Star Jel, tons	10.6
Indian Jel, tons	10
Cottonseed hulls, tons	15.2
Cedar Seal, sacks	283

Avg. Formation Tops (Drlg. depth, ft.)

Toronto lime	5,122
Tonkawa sand	5,474
Morrow sand	7,242
Chester lime	7,406

SEMINOLE UPLIFT, Seminole County
Pay: Booch, Earlsboro, 3,435 ft.

Approx. cost of well:
Flowing $32,800 on pump $38,500

Cost averages: Footage price $2.65
Day: with pipe $480; without pipe $415

Normal Rig-Time Distribution			
% on ft. rate	93.6	Total days	13
% on day rate	6.4	Total bits	17

Equipment
Fuel and water: By contractor.
Supply center: Seminole.
Terrain: Wooded hills.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	104	116
Oil string	5½	3,477	233

Typical Mud Program

Bentonite, lb.	30,000
Quebracho, lb.	700
Lost-circulation material, lb.	2,300
Soda ash, lb.	600
Caustic soda, lb.	400

Avg. Formation Tops (Drlg. depth, ft.)

Booch	3,350
Earlsboro	3,405
Wilcox	4,302

SHO-VEL-TUM, Carter County
Pay: Sims sand, 4,200 ft.

Approx. cost of well: Dry hole $30,000
Flowing $47,500 On pump $50,000

Cost averages: Footage price $5.00
Day: with pipe $550; without pipe $500

Normal Rig-Time Distribution			
% on ft. rate	91	Total days	55
% on day rate	9	Total bits	54

Equipment
Fuel: Gas. Water: Creek.
Roads: Dirt, rough.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	957	895
Oil string	5½	3,294	400

Typical Mud Program

Magcobar, sacks	1,380
Magcogel, sacks	560
Q-X quebracho, sacks	68
Fiber-Seal, sacks	30
Cell-O-Seal, sacks	15

Avg. Formation Tops (Drlg. depth, ft.)

Springer shale	1,743
Aldridge	2,028
Humphreys	3,059
Goodwin zone	3,449

SKELLYVILLE AREA, Lincoln County
Pay: Prue sand, 3,500 ft.

Approx. cost of well: Dry hole $15,000
Flowing $25,000

Cost averages: Footage price $2.65
Hourly: with pipe $20; without pipe $17

Normal Rig-Time Distribution			
% on ft. rate	95	Total days	7
% on hr. rate	5	Total bits	*16

*Retips

Equipment
Fuel: Diesel. Water: Creek.
Supply center: Cushing.
Terrain, roads: Fair.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	100	75
Oil string	4½	3,500	80

Typical Mud Program

Aquagel, sacks	75

Avg. Formation Tops (Drlg. depth, ft.)

Hogshooter lime	2,300
Checkerboard lime	2,700
Cleveland sand	2,725
Oswego lime	3,400
Prue sand	3,425

WETUMKA AREA, Okfuskee County
Pay: Bartlesville, 1,782 ft.

Approx. cost of well: Dry hole $5,900
Flowing $13,300 On pump $15,300

Cost averages: Footage price $2.65
Hourly: with or without pipe $20

Normal Rig-Time Distribution			
% on ft. rate	90	Total days	3½
% on hr. rate	10	Total bits	5

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	46	30
Oil string	4½	1,774	88

Typical Mud Program

Aquagel, lb.	4,700
Soda ash, lb.	60
Caustic soda lb.	56
Tannex, lb.	68

Texas-New Mexico

New Mexico

GRAYBURG, Eddy County
Pay: Grayburg (Premier sand), 3,540 ft.

Approx. cost of well: Dry hole $22,900
Flowing $42,300 On pump $50,800

Cost averages: Footage price $4.00

Normal Rig-Time Distribution			
Daily, without pipe			$300
% on ft. rate	80	Total days	43
% on day rate	20	Total bits	*

*Cable tool.

Equipment
Fuel: Natural gas from field.
Water: Purchased 10 miles away.
Supply center: Thirty-five miles.
Terrain: Sandy.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	711	150
Oil string	7	3,475	345

Typical Mud Program

Aquagel, sacks	5

Avg. Formation Tops (Drlg. depth, ft.)

Anhydrite	428
Salt	618
Yates	1,742
Seven Rivers	2,102
Queen	2,718
Grayburg	3,130
Premier	3,428

JALMAT, Lea County
Pay: Yates sand, 3,900 ft.

Approx. cost of well: Dry hole $27,500
Flowing $55,000 On pump $62,000

Cost averages: Footage price $3.50
Day: with pipe $600; without pipe $550

Normal Rig-Time Distribution			
% on ft. rate	95	Total days	10
% on day rate	5	Total bits	8

Equipment
Fuel: Some gas available.
Water: Hauled from Eunice.
Supply center: Eunice (15 miles).
Terrain, roads: Good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	325	300
Oil string	5½	3,900	900

Note: Cement oil string through salt at 1,500 ft.

Typical Mud Program

Brine water to 1,800 ft.	
Magcogel, tons	2.5
My-Lo-Gel, tons	2
Defoamer, lb.	100

REMARKABLE *new* RIGID PLASTIC PIPE!

★ Higher Tensile Strength
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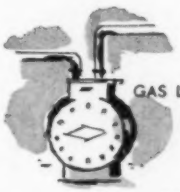

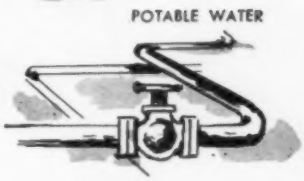

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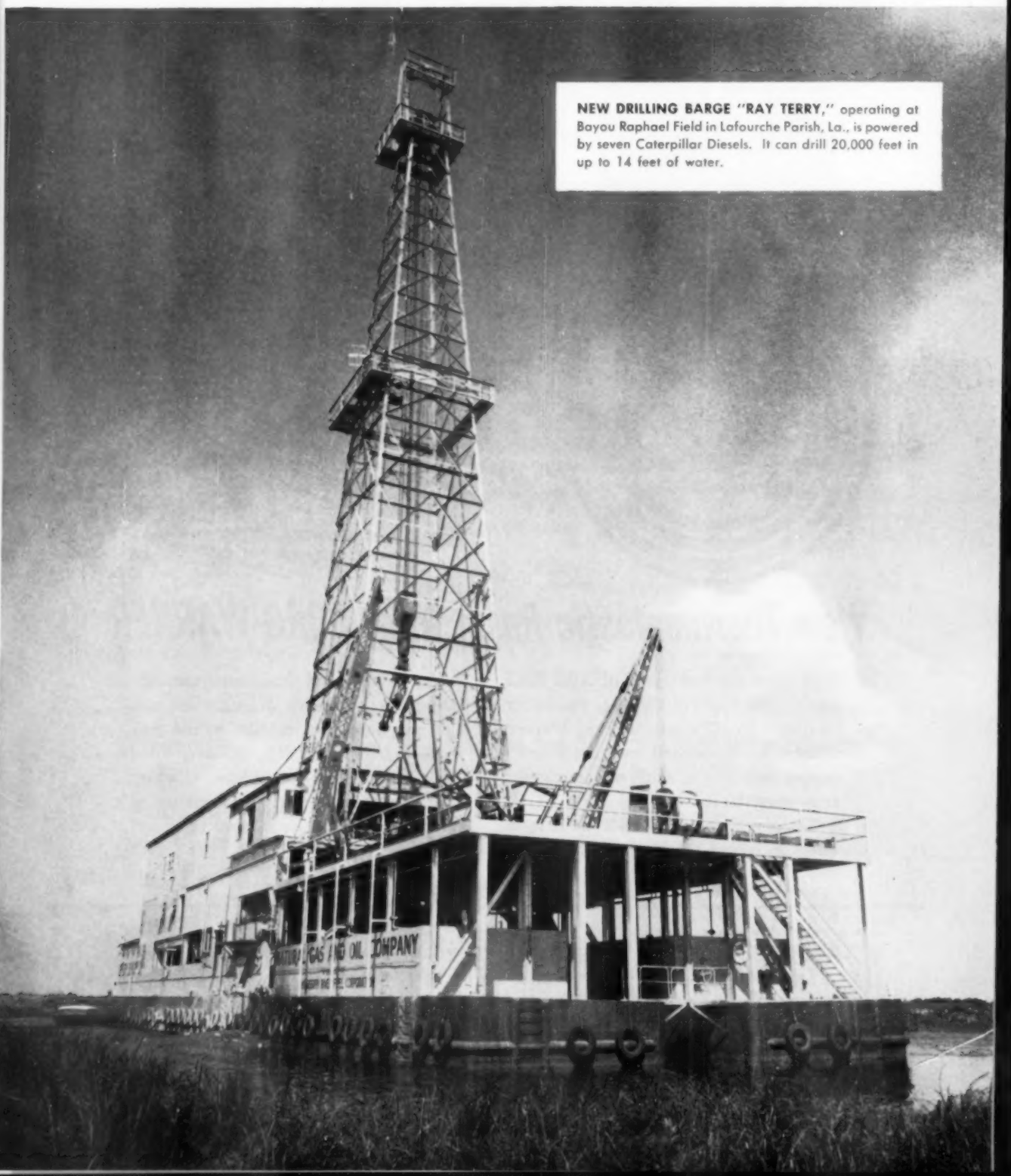
HOW THE "RAY TERRY" CUTS COSTS AND BOOSTS EARNINGS



NEW DRILLING BARGE "RAY TERRY," operating at Bayou Raphael Field in Lafourche Parish, La., is powered by seven Caterpillar Diesels. It can drill 20,000 feet in up to 14 feet of water.

ENGINE POWER BY CATERPILLAR

Ask the owners of the new 215-foot drilling barge, "Ray Terry," why they selected CAT* Diesel Electric Power and they'll give you hard dollars-and-cents reasons. Like this:

"From past experience we find Cat Oilfield Engines are the cheapest per continuous rated horsepower." That's straight from Mort Squires, assistant general superintendent for Natural Gas & Oil Company, which owns the inland drilling barge.

But just as important, the flexibility of these powerful, compact units helps assure maximum earnings. Four D397 Diesels with DC generators are compounded to drive Ideco drawworks and Emsco mud pumps. Power from these electric sets is easily directed anywhere it's needed. And, with four units, the barge loses only 25% power when an engine is shut down for maintenance. If there were just two larger units, fully half the power would be lost from down time on either one.

In addition to these four diesel-electric units, the "Ray Terry" has two D397 Turbocharged Diesel Electric Sets for auxiliary AC power and a D337 driving an Emsco pump.

Caterpillar* performance sold these engines. Their heavy-duty design has given them a reputation for dependability, low operating cost and minimum down time throughout the world. Rig owners choose the Cat power plant proven best for their needs. A full line of these four-cycle engines is available up to 650 HP (maximum). Matching generators provide up to 350 KW. When selecting your oilfield equipment always specify Cat Power.

Engine Division, Caterpillar Tractor Co., Peoria, Ill., U.S.A.

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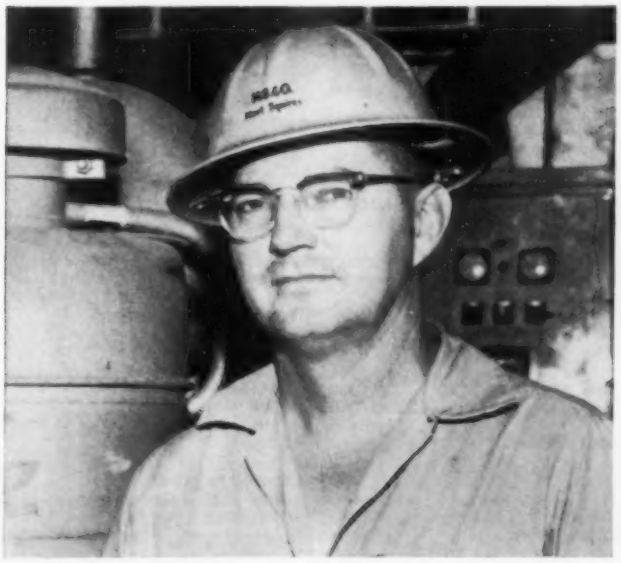
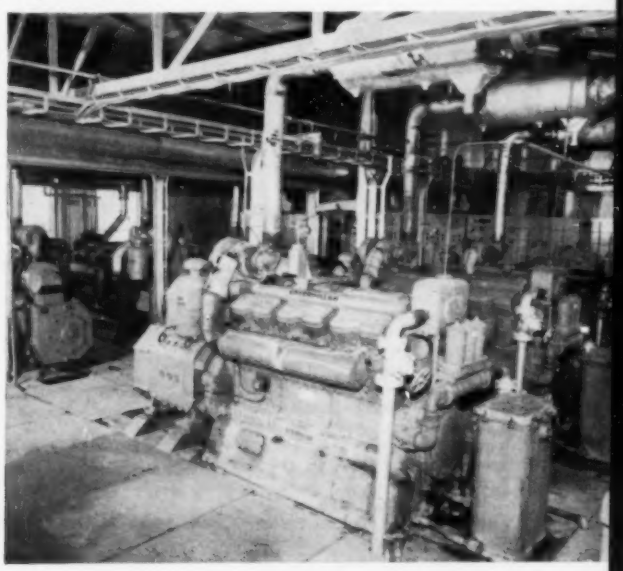
MORT SQUIRES, assistant general superintendent, reports, "We find Caterpillar Engines are dependable and economical. From past experience, we find they are the cheapest per continuous rated horsepower."



FOUR COMPACT D397s with DC generators drive Ideco drawworks and Emsco mud pumps on the "Ray Terry." These dependable turbocharged oilfield engines give the barge more flexible power at low operating cost.



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Name _____

Company _____

Address _____

City _____ Zone ____ State _____

Avg. Formation Tops (Drlg. depth, ft.)	
Anhydrite	1,670
Base Cowden Anhydrite	3,380
Tansill	3,590
Yates	3,735

North Texas

BOONSVILLE, Wise County
Pay: Bend Conglomerate, 6,000 ft.

Approx. cost of well: Dry hole $31,000
Flowing $62,000

Cost averages: Footage price $4.00
Day: with pipe $700; without pipe $600

Normal Rig-Time Distribution			
% on ft. rate	95	Total days	22
% on day rate	5	Total bits	25

Equipment
Fuel: Natural gas. Water: Limited.
Supply center: Bridgeport.
Terrain, roads: Poor to rugged.

Casing Program	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝- 10¾	150- 400	100- 200
Oil string	2⅞- 4½	6,000	200- 350

Typical Mud Program	
Gel, sacks	800
Caustic, lb.	2,000
Soda ash, lb.	2,500
Rayflo, lb.	2,000

Avg. Formation Tops (Drlg. depth, ft.)	
Bryson	1,472
Brannon Bridge	1,982
Meek Bend	2,272
Gray	2,597
Bend Conglomerate	4,089

CHICO, WEST, Wise County
Pay: Conglomerate, 5,900 ft.

Approx. cost of well: Dry hole $30,000
Flowing $60,000

Cost averages: Footage price $4.00
Day: with pipe $750; without pipe .. $650

Normal Rig-Time Distribution			
% on ft. rate	98	Total days	18
% on day rate	2	Total bits	18

Equipment
Fuel: Natural gas. Water: Wells.
Supply center: Bowie.
Terrain, roads: Hard-surface gravel, sand.

Casing Program	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	9⅝- 10¾	300	200
Oil string	5½	5,900	300

Typical Mud Program	
Gel, sacks	375
Soda ash, sacks	8
Quebracho, sacks	8
Caustic soda, sacks	8
Lignite, sacks	16

Avg. Formation Tops (Drlg. depth, ft.)	
Brannan Bridge (LM Marker)	3,660
Caddo lime (Hundley Caddo)	5,450
Caddo Conglomerate (pay)	5,615
Bend "X" Conglomerate (pay)	5,677
Lower Bend Conglomerate (pay)	5,780

Remarks: All Conglomerates are produced as common reservoir as ruled by Railroad Commission of Texas.

EAST BRYSON, Jack County
Pay: Bryson sand, 3,100 ft.

Approx. cost of well: Dry hole $12,000
Flowing $24,000 On pump $27,000

Cost averages: Footage price $2.75
Hourly rate $20

Normal Rig-Time Distribution			
% on ft. rate	95	Total days	6
% on hr. rate	5	Total bits	7

Equipment
Fuel: Butane or gas. Water: Tanks.
Supply center: Graham.
Terrain, roads: Rough.*

Casing Program	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	350	125
Oil string	5½	3,100	75

Typical mud program includes $300 to $500 worth of gel, caustic, soda ash, and quebracho.

REGULAR, Baylor County
Pay: Tannehill sand, 1,500 ft.

Approx. cost of well: Dry hole $3,700
Flowing $11,500 On pump $13,000

Cost averages: Footage price $1.75
Day: with pipe $550; without pipe $500

Normal Rig-Time Distribution			
% on ft. rate	75	Total days	4
% on day rate	25	Total bits	2

Equipment
Fuel: Butane. Water: Stock tanks.
Supply center: Wichita Falls.
Terrain, roads: Good.

Casing Program	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝- 10¾	60	40- 50
Oil string	4½	1,480	75

Note: Setting through pay gives better completions.

Typical Mud Program	
Gel, sacks	25
Soda ash, sacks	3

REGULAR, Wichita County
Pay: 1,570 ft. Avg. TD is 1,800 ft.

Approx. cost of well: On pump $15,000

Cost averages: Footage price $1.40
Hourly rate $20

Normal Rig-Time Distribution			
% on ft. rate	99	Total days	4
% on hr. rate	1	Total bits	1

Equipment	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	60	50
Oil string	4½	1,890	100

WHITESBORO, Grayson County
Pay: Mississippian sand, 3,660 ft.

Approx. cost of well: Dry hole $12,810

Cost averages: Footage price $2.75
Hourly: with pipe $18; without pipe $15

Normal Rig-Time Distribution			
% on ft. rate	100	Total days	9
% on hr. rate	....	Total bits	15

Equipment
Fuel: Butane. Water: Creek.
Supply center: Whitesboro.
Terrain, roads: Good.

Casing Program	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	105	50

Typical mud program includes $618 of Baroid.

South Texas

MISSION RIVER, Refugio County
Pay: 6,550 ft.

Approx. cost of well: Dry hole $25,000
Flowing $55,000

Cost averages: Footage price $2.25
Day: with pipe $650; without pipe ... $600

Normal Rig-Time Distribution			
% on ft. rate	75	Total days	18
% on day rate	25	Total bits	7

Equipment
Fuel: Gas. Water: 400-ft. deep wells.
Supply center: In field.
Terrain, roads: Rough. Good roads.

Casing Program	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	1,250	600
Oil string	5½	6,550	400

Mud bill averages $623.

Texas Gulf Coast

HUMBLE, Harris County
Pay: Yegua, 5,200 ft.

Approx. cost of well: On pump $38,000
Footage price averages $2.85

Normal Rig-Time Distribution			
% on ft. rate	82	Total days	17
% on day rate	18	Total bits	12

Equipment
Fuel: Natural gas. Water: Wells.
Supply center: Houston.
Terrain, roads: Good.

Casing Program	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	300	....

Note: D. V. tool required at 2,400 ft.

PALACIOS, Matagorda County
Pay: Frio, 8,850 ft.

Approx. cost of well: Dry hole $70,000
Flowing $105,000

Cost averages: Footage price $2.90
Day: with pipe $875; without pipe $800

Normal Rig-Time Distribution			
% on ft. rate	75	Total days	30
% on day rate	25	Total bits	16

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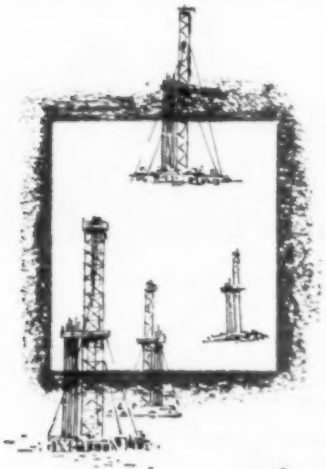

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Equipment
Fuel: Diesel. Water: Well.
Supply centers: Houston, Victoria.
Terrain, roads: Fair.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	16	60	50
Intermediate	10¾	2,000	875
Oil string	5½	8,850	500

Typical Mud Program

Magcobar, sacks	3,515
Magcogel, sacks	27
Quebracho, sacks	135
Caustic, sacks	26
Magcophos, sacks	8

Avg. Formation Tops (Drlg. depth, ft.)

Base Miocene	5,900
Frio	7,584

RED FISH BAY, Chambers County
Pay: 9,564 ft. TD avg. is 9,681 ft.

Total days (spud to rig release)	26
Total number of bits	13

Equipment
Fuel: Gas. Water: Well.
Supply center: Houston.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	9⅝	3,500	750
Oil string	5½	9,600	600

Typical Mud Program

Bentonite, bbl.	4,000
Barite, sacks	500
Caustic soda, lb.	1,000
Quebracho, lb.	2,500
Phosphate, lb.	3,700
Lime, lb.	500

Avg. Formation Tops (Drlg. depth, ft.)

Miocene	Surface
Frio	8,670

SOUTHWEST RED FISH REEF, Chambers County
Pay: Frio sands, 10,850 ft.

Approx. cost of well: Dry hole	$200,000
Flowing	$275,000
Cost averages: Footage price	$5.15
Day: with pipe $1,250; without pipe	$1,150

Normal Rig-Time Distribution

% on ft. rate	80	Total days	50-80
% on day rate	20	Total bits	35

Equipment
Fuel: Diesel. Water: Well.
Supply center: Double Bayou.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	30	60	
	16	250	360
Intermediate	10¾	2,500	1,500
Oil String	5½-7	TD	75

Typical Mud Program

Barite, tons	100
Gel, tons	8
Lime, sacks	500
CMC, sacks	40
Kembreak, sacks	300
Caustic soda, lb.	4,000
Diesel oil, gal.	8,000

Avg. Formation Tops (Drlg. depth, ft.)

Frio (F-4)	9,200
Frio (F-8)	9,744
Frio (F-11B)	10,164
Frio (F-12)	10,343
Frio (F-15)	10,700

THEUVENINS CREEK, Tyler County
Pay: 8,492 ft. TD avg. is 8,600 ft.

Normal Rig-Time Distribution

% on ft. rate	95	Total days	16
% on day rate	5	Total bits	10

Equipment
Fuel: Natural gas. Water: Well.
Supply center: Beaumont.
Terrain: Wooded.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	9⅝	1,700	950
Oil string	5½	8,590	325

Typical Mud Program

Magcobar, sacks	1,065
Q-Broxin, sacks	52
Tannathin, sacks	58
Caustic, cans	13
Diesel oil, gal.	6,000

Texas Panhandle

EAST PANHANDLE, Collingsworth County
Pay: Brown dolomite, 2,000 ft.

Approx. cost of well: Dry hole	$8,000
Flowing	$25,000

Normal Rig-Time Distribution

% on ft. rate		Total days	3
% on day rate	100	Total bits	3

Equipment
Fuel: Diesel. Water: Creeks.
Supply center: Pampa.
Terrain, roads: Gentle, rolling hills, with creeks. Dirt, semi-improved roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	7-8⅝	600-800	200-500
Oil string	5½-4½	2,000	125

Avg. Formation Tops (Drlg. depth, ft.)

Panhandle limestone	1,600
Brown dolomite	2,000

Remarks: Wells are air-drilled from surface to TD.

EAST PANHANDLE, Gray County
Pay: Brown dolomite, 2,500 ft.

Approx. cost of well:	Flowing $20,000

Footage price averages $2.40.

Normal Rig-Time Distribution

% on ft. rate	100	Total days	3½
		Total bits	4

Equipment
Fuel: Natural gas or butane.
Supply center: Pampa.
Terrain, roads: Rough.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	9⅝	350	500
Oil string	5½	2,500	125

Typical Mud Program

Salt gel, sacks	25
Starch, sacks	50
Fiber, sacks	6
Cottonseed hulls, sacks	13

Avg. Formation Tops (Drlg. depth, ft.)

Dolomite	2,300
Granite Wash	2,400

FARNSWORTH, Ochiltree County
Pay: Basal Lower Morrow (gas 8,710 ft.), Upper Des Moines lime (oil, 6,993 ft.), 8,800 ft.

Approx. cost of well:	Flowing $120,000
Cost averages: Footage price	$5.50
Day: with pipe $825; without pipe	$750

Normal Rig-Time Distribution

% on ft. rate	75	Total days	42
% on day rate	25	Total bits	35

Equipment
Fuel: Diesel. Water: Well.
Supply center: Perryton.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	*2,650	200
Oil string	5½	8,800	470

*Using stage collar at 550 ft.; cementing with 550 sacks.

Typical Mud Program

Aquagel, sacks	1,045
Zeogel, sacks	93
Barafloc, sacks	10
Tannex, sacks	16
Carbonax, sacks	116
Fibertex, sacks	145
Plug Git, sacks	70
Lime, sacks	11
Caustic soda, sacks	57
Soda ash, sacks	65
Kero-X, drums	3
DME, drums	3
Cottonseed hulls, sacks	830

Avg. Formation Tops (Drlg. depth, ft.)

Douglas	5,476
Lower Missouri sand	6,712
Upper Des Moines lime	6,993-7,081
Basal Lower Morrow sand	8,564-8,578
Mississippian	8,600

HANSFORD-MORROW, Hansford County
Pay: 6,800-7,800 multizone, 7,800 ft.

Normal Rig-Time Distribution

% on ft. rate	97	Total days	30
% on day rate	3	Total bits	30

Equipment
Fuel: Natural gas. Water: Well.
Supply centers: Borger, Pampa.
Terrain: Flat farm land.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	2,800	1,600
Oil string	4½		700

Mud program includes oil emulsion, low solid. Quantity varies because of lost returns.

Avg. Formation Tops (Drlg. depth, (ft.)

Wolfcamp	3,100
Cisco	5,000
Canyon	5,500
Strawn	6,200
Morrow	7,000
Mississippian	7,800

CEMENTING DATA

Job: Richardson & Bass-Mecom-Freeport-Humble-LL&E-SL2414, Well No. 1-L.
Location: Lake Washington Field, Plaquemines Parish, La.
Log. Temp.: 326°F.
Detail: Squeeze Job #4—Cast-iron retainer was set at 21,020 ft. to replug and abandon perforations from 21,419 to 21,465 ft. Dry blend for this job was made up of 30,550 lbs. of UNAFLO cement, 22,800 lbs. of barite, 347 lbs. CMHEC (0.65%); 58 bbls. of water used for 100 bbls. of 17.5 lbs. per gal. slurry. Mixing time was 58 min. At the end of 1 hr. and 59 min. pressure build-up observed, with 88 bbls. squeezed. At pressure of 3,400 psi (casing pressure was 2,000 psi) retainer moved up hole and job bradenhead squeezed to completion. At 2 hrs. and 12 min. (from the start of mixing) 5,800 lbs. obtained, with 95 bbls. squeezed out. Reverse-out of remaining 5 bbls. effected. **Squeeze Job, #5, 6, 7**—All similar patterned after #4. CMHEC decreased to 0.56%. In all 3, final squeeze pressure was 6,000 psi. Reverse-outs were 10 bbls., 10 bbls., 12 bbls., respectively. No difficulty on any reverse-outs because reversed cement quite fluid on recovery.

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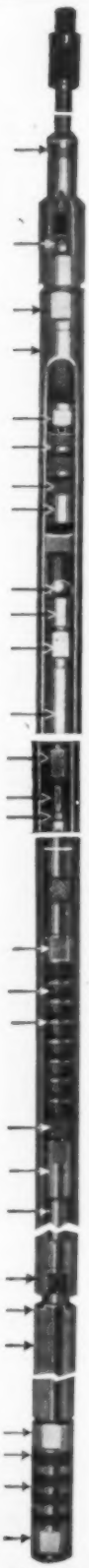

Figs. 600-800-900

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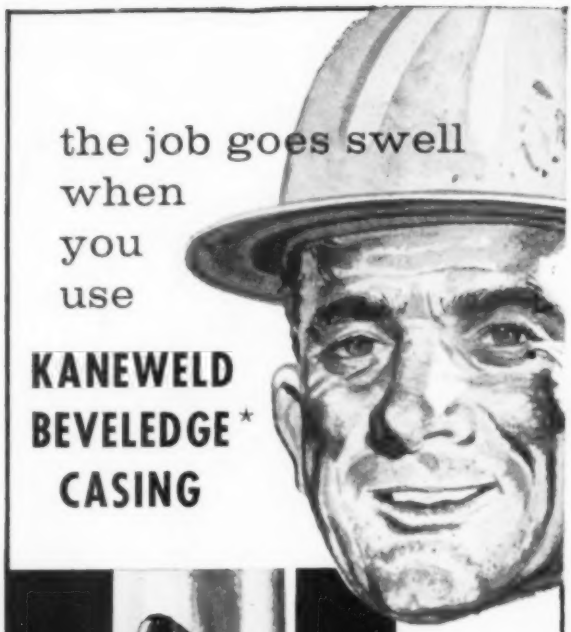

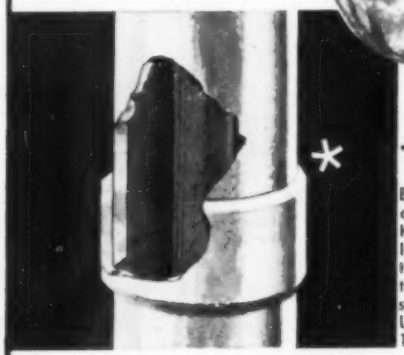

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ACTIVE FIELDS

PERRYTON, Ochiltree County
Pay: Lower Morrow sand, 8,800 ft.

Approx. cost of well: Dry hole $70,000
Flowing $120,000.

Cost averages: Footage price $5.00
Day: with pipe $825; without pipe $750

Normal Rig-Time Distribution

% on ft. rate	95	Total days	30
% on day rate	5	Total bits	30

Equipment
Fuel: Butane, or diesel. Some gas.
Water: Wells and ponds.
Supply centers: Pampa, Borger.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	7⅝	2,900	(*)
Oil string	4½	8,800	300

*250 sacks first stage; 500 second stage.

Typical Mud Program

Bentonite gel, sacks	1,000
Fiber and hulls, sacks	700
Salt gel, sacks	50
Caustic, cans	25
Soda ash, sacks	75
Tannic product, sacks	90

Avg. Formation Tops (Drlg. depth, ft.)

Anhydrite	2,900
Douglas sand	5,300
Tonkawa sand	5,600
Cleveland sand	6,800
Atoka	7,700
Lower Morrow (Elliott sand)	8,400

West Texas

FUHRMAN-MASCHO, Andrews County
Pay: Grayburg San Andres, 4,500 ft.

Approx. cost of well: Dry hole $30,000
Flowing $52,000 On pump $62,000

Cost averages: Footage price $3.50
Day: with pipe $750; without pipe $700

Normal Rig-Time Distribution

% on ft. rate	80	Total days	16
% on day rate	20	Total bits	11

Equipment
Fuel: Butane. Water: Hauled in.
Supply center: Andrews.
Terrain, roads: Good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝		Circulate
	9⅝		
Oil string	5½		250

GERALDINE-FORD, Culberson County
Pay: Delaware sand, 2,600 ft.

Approx. cost of well: Dry hole $14,000
Flowing $25,000 On pump $32,000

Cost averages: Footage price $4.25
Day rate—cable tool $350

Normal Rig-Time Distribution

% on ft. rate	90	Totals days	20
% on day rate	10		

Equipment
Fuel: Butane. Water: Trucked in.
Supply centers: Orla.
Terrain, roads: Rough.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	225	200
Oil string		2,600	200-400

Note: In some cases, 2,000 sacks of cement had to be run due to loss circulation or crevices.

Typical mud program includes about 2 tons of Zeogel and Fiber-Tex. Mud is used to stop cave and to keep the anhydrite from setting up in case of fishing job below the surface pipe to TD.

GOLDSMITH, Ector County
Pay: Clear Fork, 5,850 ft.

Approx. cost of well: Flowing $59,500

Cost averages: Footage price $4.00
Day: with pipe $665; without pipe $600

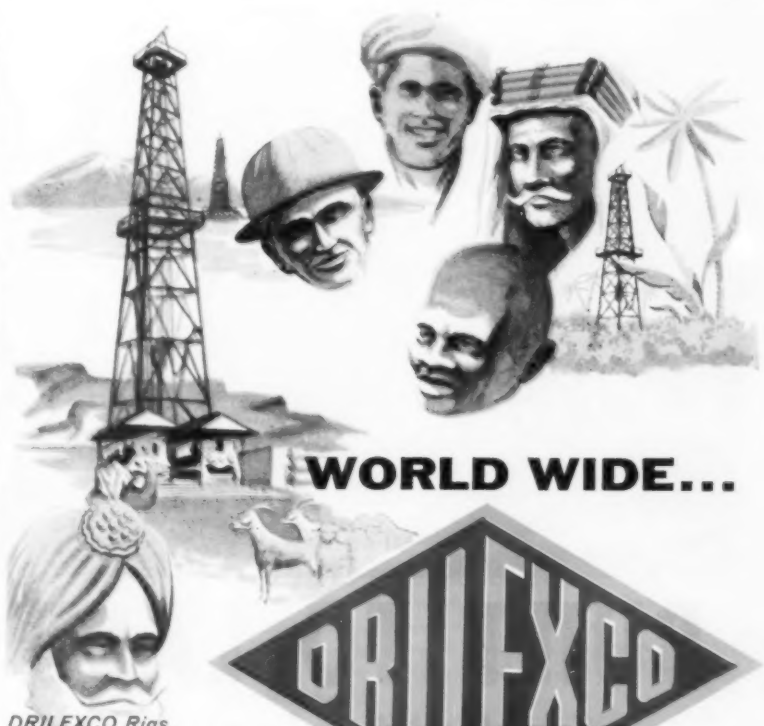
Normal Rig-Time Distribution

% on ft. rate	80	Total days	20½
% on day rate	20	Total bits	19

Equipment
Fuel: Diesel. Water: Field pipeline.
Supply center: Goldsmith.
Terrain, roads: Good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	7⅝	1,507	450
Oil string	4½	5,840	*



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ACTIVE FIELDS

*Use 300 sacks in first stage; use 1,500 cu. ft. of cement slurry in second stage. Two-in. tubing used in completion.

Typical Mud Program

Brine, bbl.	1,443
Oil, bbl.	308
Starch, lb.	2,180
Defoamer, drums	2
Lost circulation material, sacks.	7

Avg. Formation Tops (Drlg. depth, ft.)

Yates	2,667
San Andres	4,063
Glorietta	5,215
Clearfork	5,507

Remarks: Potential of these wells after fracturing on initial completion is about 300 BOPD. Allowable is 109 BOPD.

HALLANAN (Strawn), Midland County
Pay: Pennsylvanian, 10,790 ft.

Approx. cost of well: Dry hole $100,000
Flowing $163,000 On pump $183,000

Cost averages: Footage price $5.25
Day: with pipe $825; without pipe $750

Normal Rig-Time Distribution

% on ft. rate	96	Total days	49
% on day rate	4	Total bits	55

Equipment

Fuel: Butane. Water: Lease well.
Supply centers: Midland, Odessa.
Terrain, roads: Level. Good roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	13⅜	309	275
Intermediate	9⅝	4,759	2,825
Oil string	5½	10,790	400

Note: Cement circulated on salt string; not on surface string.

Typical Mud Program

Water from 0 to 10,000 ft. Low solids Driscose from 10,000 to 10,800 ft. Mud bill is approximately $2,500.

IAB, Coke County
Pay: Menielle IAB Penn Reef and Canyon sands, 5,800 ft.

Approx. cost of well: Flowing $60,750
Flowing (dual completion) $83,066

Cost averages: Footage price $5.00
Day: with pipe $750; without pipe $650

Normal Rig-Time Distribution

% on ft. rate	82	Total days	26-29
% on day rate	18	Total bits	30

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	9⅝	400	*250
Oil string	5½-7	5,900	*400

*4% gel.

Typical Mud Program

Aquagel, lb.	32,600
Man Tan, lb.	1,000
Fibertex, lb.	400
Caustic soda, lb.	1,200
Cottonseed hulls, lb.	975
Soda ash, lb.	5,700

Avg. Formation Tops (Drlg. depth, ft.)

Canyon sand	5,100
Menielle Reef	5,425

JO MILL (Spraberry), Borden County
Pay: 7,250-7,350 ft. Avg. TD, 7,350 ft.

Approx. cost of well: Dry hole $45,000
Flowing $80,000 On pump $90,000

Cost averages: Footage price $4.25
Day: with pipe $800; without pipe $750

Normal Rig-Time Distribution

% on ft. rate	95	Total days	25
% on day rate	5	Total bits	29

Equipment

Fuel: Butane. Water: Local tanks.
Supply center: Snyder.
Terrain: Rolling hills and canyons.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	13⅜	300	300
Intermediate	8⅝	3,300	500-750
Oil string	5½	7,350	250-500

Note: Clear water to core point (if cored), then oil emulsion mud to TD. If no intermediate casing is set, a salt water mud is used from 1,800 ft. to TD. Some lost circulation material is required—leather, hulls, and fiber.

Avg. Formation Tops (Drlg. depth, ft.)

Tansill	1,400
Salt section	1,800
Yates	2,430

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ACTIVE FIELDS

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McELROY, Crane County
Pay: Grayburg, 3,100 ft.

Approx. cost of well: Dry hole ... $20,000
Flowing $41,000 On pump ... $47,000

Cost averages: Footage price $3.50
Day: with pipe $650; without pipe $400

Normal Rig-Time Distribution

% on ft. rate	97	Total days	7
% on day rate	3	Total bits	11

Equipment
Fuel: Butane. Supply center: Odessa.
Roads: Black top.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	190	150
Oil string	5½	3,100	1,000

Typical Mud Program

Controlgel, sacks	25
Brinegel, sacks	50
Controloid, oil base, sacks	50

Note: Spud mud for surface; clear water to 2,700 ft.; starch, brinegel, and oil through pay zone.

Avg. Formation Tops (Drlg. depth, ft.)

Yates	7,000
Grayburg	7,950

PUCKETT, Pecos County
Pay: Ellenburger, 14,740 ft.

Approx. cost of well: Dry hole ... $330,000
Flowing $450,000

Cost averages: Footage price $9.15
Day: with pipe*; without pipe ... $1,000
*$1,000 plus 1½c per foot for pipe.

Normal Rig-Time Distribution

% on ft. rate	33	Total days	153
% on day rate	67	Total bits	125

Equipment
Fuel: Natural gas. Water: 700 ft. well.
Supply center: McCamey.
Terrain: Sandy with rocky bluffs.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	13⅜	1,100	600
Intermediate	9⅝	5,400	1,000
Oil string	7	13,900	1,700

Typical Mud Program

Gel, loss circulation material, sacks	200
Brine, bbl.	2,300
Crude oil, bbl.	200
My-Lo-Jel, sacks	344
Salt gel, sacks	385
Pine oil, gal.	100

Note: Surface hole—spud mud; intermediate hole—drill with gas; production hole—salt-base oil emulsion.

Avg. Formation Tops (Drlg. depth, ft.)

Pennsylvanian	10,300
Mississippian	10,750
Devonian	11,600
Fusselman	11,800
Ellenburger	14,100

ROBERTSON, Gaines County
Pay: Clearfork, 6,980 ft.

Approx. cost of well: Pump ... $107,000

Cost averages: Footage price $5.00
Day: with pipe $700; without pipe $600

Normal Rig-Time Distribution

% on ft. rate	98	Total days	30
% on day rate	2	Total bits	30

Equipment
Fuel: Lease gas.
Supply center: Hobbs, N. M.
Terrain, roads: Flat, sandy. Caliche.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	11¾	326	*225
Intermediate	8⅝	3,128	*500
Oil string	5½	6,979	**200

*4% gel. **Plus 200 cu. ft. strata crete No. 6.

Typical Mud Program

Gel, sacks	35
Salt gel, sacks	318
Starch, sacks	94
Lime, caustic, quebracho, sacks	*

*1 to 2 sacks each as required.

Avg. Formation Tops (Drlg. depth, ft.)

Rustler	1,850
Yates	2,930
San Andres	4,630
Glorietta	5,870
Clearfork	6,370

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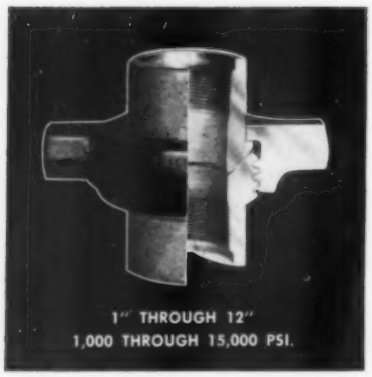

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ACTIVE FIELDS

SABRE, Reeves County
Delaware, 3,041 ft.

Approx. cost of well: Flowing $29,519

Cost averages: Footage price ... $3.25
Day: with pipe $650; without pipe $600

Normal Rig-Time Distribution

% on ft. rate	75	Total days	13
% on day rate	25	Total bits	8

Equipment
Fuel and water: Contractor.
Supply center: Kermit.
Terrain: Level, sandy.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	416	300
Oil string	5½	3,042	375

Typical Mud Program

Magcogel, tons	1.95
Cottonseed hulls, tons	.30
Lime, sacks	3
Salt gel, tons	2.44
My-Lo-Jel, lb.	1,700

Avg. Formation Tops (Drlg. depth, ft.)

Rustler	380
Salado	550
Castile	1,190
Lamar lime	2,905
Delaware	2,930

SHAFTER LAKE, Andrews County
Pay: San Andres, 4,650 ft.

Approx. cost of well: Dry hole $27,000
Flowing $40,000. On pump $46,000

Cost averages: Footage price ... $2.75
Day: with pipe $650; without pipe $600

Normal Rig-Time Distribution

% on ft. rate	78	Total days	18
% on day rate	22	Total bits	13

Equipment
Fuel: Butane. Water: Contract, $450/well.
Supply center: Andrews.
Terrain: Low relief, sandy loam.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝-10¾	210	200
Oil string	5½	4,695	250

Typical Mud Program

Gel, sacks	115
Starch, sacks	95
Salt water used from surface to	3,700 ft.

Avg. Formation Tops (Drlg. depth, ft.)

Rustler	1,960
Yates	3,060
Grayburg	4,450
San Andres	4,600

SONORA, Sutton County
Pay: Canyon sands, 6,000 ft.

Approx. cost of well: Dry hole $50,000
Flowing $90,000.

Cost averages: Footage price ... $4.50
Day: with pipe $750; without pipe $675

Normal Rig-Time Distribution

% on ft. rate	100	Total days	18-20
% on day rate	...	Total bits	20

Equipment
Fuel: Diesel. Water: Hauled from Sonora.
Supply center: San Angelo.
Terrain, roads: Rolling. Caliche roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	600	300
Oil string	5½	6,000	500

Avg. Formation Tops (Drlg. depth, ft.)

Base Wolfcamp	4,800
Canyon	5,200

SOUTH KERMIT, Winkler County
Pay: Devonian, 8,450 ft.
Approx. cost of well: Dry hole $116,500
Flowing $166,000.

Cost averages: Footage price ... $7.10
Day: with pipe $950; without pipe $850

Normal Rig-Time Distribution

% on ft. rate	93	Total days	38
% on day rate	7		

Equipment
Fuel: Natural gas. Water: Shallow wells.
Supply center: Kermit (3 miles).
Terrain, roads: Good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	13⅜	900	500
Intermediate	9⅝	3,700	1,400
Oil string	5½-7	8,450	500

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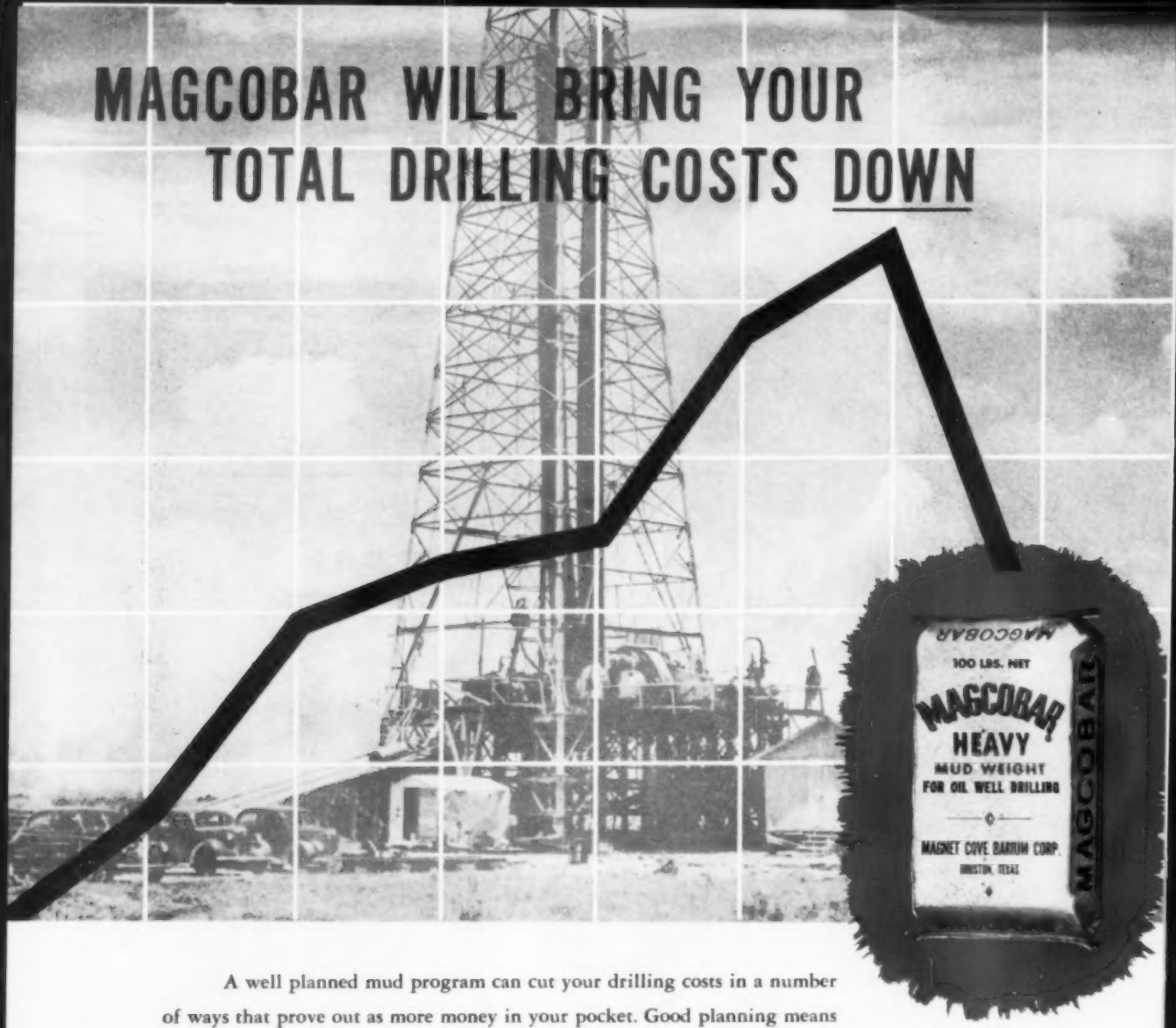

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ACTIVE FIELDS

Typical Mud Program

Magcobar, tons	29
Magcogel, tons	21
Caustic, quebracho, tons	3
Driscose, soda ash, tons	1.5
Brine (to 3,800 ft.), bbl.	3,250

Avg. Formation Tops (Drlg. depth, ft.)

Yates	2,500
San Andres	3,800
Mississippian	7,550
Devonian	8,350
Silurian	8,540

TWOFREDS, Ward and Loving counties
Pay: Delaware sand, 4,700 to 4,950 ft.

Approx. cost of well: Dry hole $27,000
Flowing $50,000. On pump $61,000

Cost averages: Footage price $4.00
Day: with pipe $700; without pipe $650

Normal Rig-Time Distribution

% on ft. rate	95	Total days	15
% on day rate	5	Total bits	11

Equipment
Fuel: Butane. Water: Well.
Supply center: Kermit.
Terrain, roads: Sand. Caliche roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	525	175
Oil string	5½-4½	TD	150

Typical Mud Program

Salt gel, sacks	30
Starch, sacks	30
Oil, bbl.	50

Drill with fresh water or brine to pay.

Avg. Formation Tops (Drlg. depth, ft.)

Rustler	1,200
Castile	4,650
Delaware lime	4,680
Delaware sand	TD

TXL TUBB, Ector County
Pay: Tubb sand, 6,350 ft.

Cost averages: Footage price $4.25
Day: with pipe $725; without pipe $675

Normal Rig-Time Distribution

% on ft. rate	83	Total days	28
% on day rate	17	Total bits	26

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	200	100
Oil string	5½	TD	400

Typical Mud Program

Gel, sacks	25
Starch, sacks	45
Crude oil, bbl.	400

Avg. Formation Tops (Drlg. depth, ft.)

Red Bed	90-160
San Andres	4,110
Glorietta	5,150
Clearfork	5,474
Tubb	6,022

Louisiana

North

MINDEN, Webster Parish
Pay: Paluxy, 7,500 ft. (dual completion)

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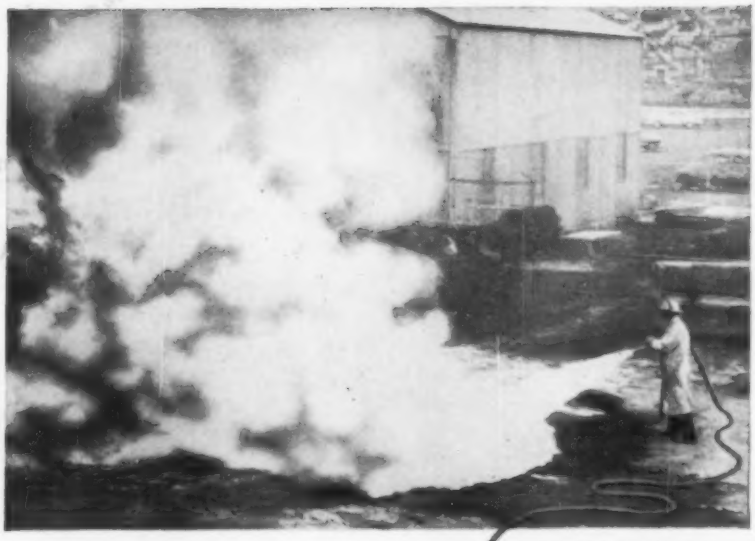

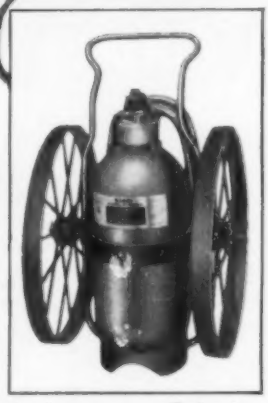

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ACTIVE FIELDS

Approx. cost of well: Dry hole $100,000
Flowing $163,000 On pump $192,000
Cost averages: Day rate is $750 plus 1½ cents per foot of pipe per day.

Normal Rig-Time Distribution

% on day rate	100	Total days	52
		Total bits	34

Equipment

Fuel: Natural gas. Water: Pond.
Supply center: Shreveport.
Terrain: Gently rolling.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	20	200	275
Intermediate	9⅝	1,000	1,000
Oil string	7	7,500	1,000

Note: Set 20 in. surface to accommodate 13⅜ in. if necessitated by encountering salt.

Typical Mud Program

Gel, lb.	17,000
Clay, lb.	5,000
Barites, lb.	125,000
Caustic, lb.	2,500
Quebracho, lb.	5,000
Diesel oil, bbl.	200

Avg. Formation Tops (Drlg. depth, ft.)

Nacatoch	2,900
Tokio	4,300
Tuscaloosa	5,300
Lower Cretaceous	5,900
Paluxy	6,500

Remarks: Well drilled in immediate vicinity of piercement salt dome.

South

BAYOU CHOCTAW, Iberville Parish
Pay: Miocene sands, 6,000 to 8,500 ft.

Cost averages: Footage price $4.40
Day: with pipe $800; without pipe $700

Normal Rig-Time Distribution

% on ft. rate	75	Total days	30
% on day rate	25	Total bits	17

Equipment

Fuel: Natural gas. Water: Wells.
Supply centers: Houma; Baton Rouge
Terrain, roads. Swampy. Board roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	800-1,600	500-1,100
Oil string	7	6,000-8,000	400-500

Typical Mud Program

Barite, sacks	250-1,800
Gel, sacks	200- 150
Clays, sacks	85- 100
Chemicals, sacks	100-1,000

Note: First total of sacks is for 6,000-ft. depths; second total is for 8,000-ft. depths.

Remarks: Due to extremes in faulting, formation depths are variable.

BLACK BAY, Plaquemines Parish
Pay: 8,100 to 9,200 ft.

Approx. cost of well: Flowing $173,000

Cost averages: Footage price $3.00

ACTIVE FIELDS

Day: with pipe $1,650; without pipe $1,550

Normal Rig-Time Distribution

% on ft. rate	65	Total days	14
% on day rate	35	Total bits	8

Equipment

Fuel: Diesel. Water: Barge fresh water. Supply center: Venica.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	2,500	1,600
Oil string	7	9,300	900

Typical Mud Program

Barite, sacks	75
Gel, sacks	80
Clay, sacks	40
SAPP, lb.	1,800
CMC, sacks	8

Remarks: Formations are sandy shale between sand tops.

ERATH, Vermilion Parish
Pay: Broussard sand, 12,650 ft.

Approx. cost of well: Dry hole $175,000
Flowing $205,000

Normal Rig-Time Distribution

% on ft. rate	75	Total days	28
% on day rate	25	Total bits	20

Equipment

Fuel: Gas. Water: Shallow wells.
Terrain, roads: Flat. Gravel roads. Board roads are used on lease then shelled after well is completed.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	9⅝	4,500	765
Oil string	5½	12,650	230

Typical Mud Program

Weight, sacks	1,050
Gel, sacks	500
Clay, sacks	125
Caustic soda, drums	20
Quebracho, sacks	75

Avg. Formation Tops (Drlg. depths, ft.)

School Board gas sand	12,000
Derouen gas sand	12,150
Broussard oil sand	12,400

Note: These producing sands are in the Lower Miocene.

JENNINGS, Acadia Parish
Pay: 9,591-9,632. Avg. TD 10,960.

Approx. cost of well: Flowing $173,000

Cost averages: Footage price $4.50
Day: $930 plus rental with pipe.

Total days (spud to rig release) 50
Total number of bits 27

Fuel: Gas. Water: Well.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	16	93	150
Intermediate	10¾	3,018	1,784
Oil string	7⅝	10,304	500

LAKE ARTHUR, Jefferson Davis Parish
Pay: Marginulina Howie, 14,825 ft.

Approx. cost of well: Flowing $585,000

Cost averages: Footage price $4.75

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- Full control of quality to produce "Best in Industry!"

For information about 1025 steel and for your commercial forging requirements, write to Forge and Fittings Division, H. K. Porter Company, Inc., Box 95, Roselle, New Jersey.

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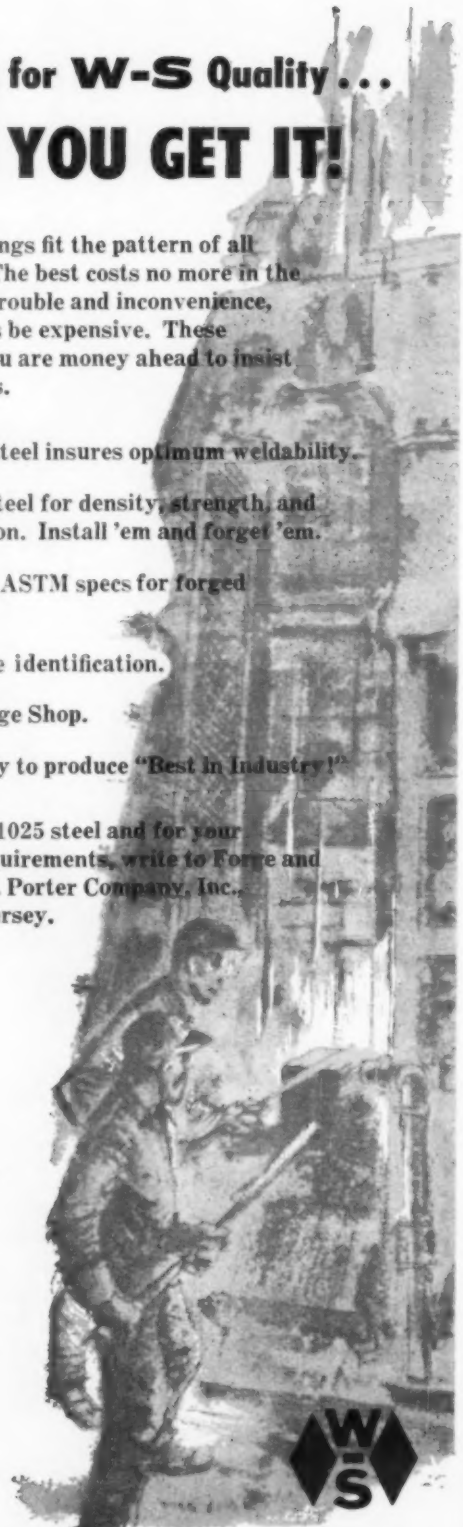
ROUGH FORGING AFTER TRIMMING

FINISHED FITTING



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Stainless Steel Works, Duncannon, Pa.

ACTIVE FIELDS

Day. with pipe $1,195; without pipe $945

Normal Rig-Time Distribution

% on ft. rate	25	Total days	120
% on day rate	75	Total bits	53

Equipment

Fuel: Natural gas. Water: Well.
Supply center: Jennings.
Terrain, roads: Flat. Hardtop road adjacent to location.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	20	130	180
Intermediate	13⅜	3,036	2,050
	9⅝	10,650	500
Oil string	7	14,369	1,385

Typical Mud Program

Barite, sacks	23,415
Clay, sacks	353
Lime, sacks	1,137
Starch, sacks	216
Quebracho, sacks	939
Kembreak, sacks	100
Caustic, lb.	660
CMC, sacks	13

Avg. Formation Tops (Drlg. depth ft.)

Marginulina Howie	12,808
U. Camering	14,150

Canada

Alberta

BELLSHILL LAKE

Pay: Cameron sand (lower Cretaceous) 3,000 ft.

Approx. cost of well: Dry hole $24,400
Flowing $38,000 On pump $45,800

Cost averages: Footage price $2.25
Day: with pipe $768; without pipe $720

Normal Rig-Time Distribution

% on ft. rate	60	Total days	9
% on day rate	40	Total bits	4

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	470	285
Oil string	5½	3,000	190

Typical Mud Program

Gel, water, sacks	40
Caustic soda, lb.	50
Quebracho, lb.	50

Avg. Formation Tops (Drlg. depth, ft.)

Viking	2,488
Blairmore	2,652
Cameron sand	2,975

CESSFORD

Pay: Upper and lower Cessford (lower Cretaceous), upper-3,000 ft., lower-3,400 ft.

Approx. cost of well: Dry hole $24,000
Flowing $39,400 On pump $47,000

Cost averages: Footage price $2.35
Day: with pipe $816; without pipe $600

Normal Rig-Time Distribution

% on ft. rate	60	Total days	10
% on day rate	40	Total bits	6

Equipment supply center: Calgary

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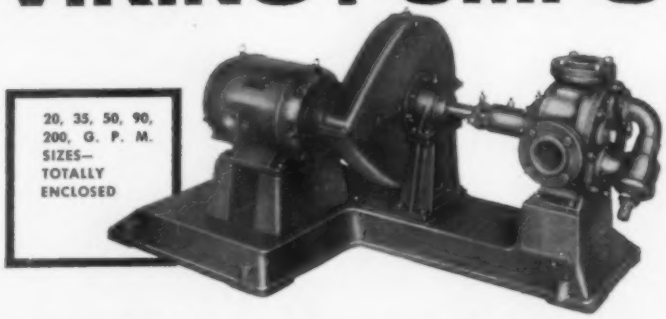

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ACTIVE FIELDS

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	300	180
Oil string	5½	3,000-3,400	500-600

Typical Mud Program

Gel, Water, sacks	80
Caustic soda, lb.	200
Quebracho, lb.	120
SAPP, lb.	200

Avg. Formation Tops (Drlg. depth, ft.)

Viking	2,700
Upper Cessford	2,950
Lower Cessford	2,350

HARMATTAN EAST
Pay: Mississippian Elkton, 8,650 ft.

Approx. cost of well: Dry hole $80,000
Flowing $130,000

Cost averages: Footage price $5.75
Day: with pipe $1,100; without pipe $1,000

Normal Rig-Time Distribution

% on ft. rate	75	Total days	40
% on day rate	25	Total bits	30

Equipment
Water: Well. Supply center: Red Deer
Terrain: Bush and farmland.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	600	500
Oil string	5½	8,650	700

Typical Mud Program
Water and separan to 5,000 ft.
Milk emulsion to TD

Avg. Formation Tops (Drlg. depth, ft.)

Second White Specks	7,000
Blairmore	7,750
Home sand	8,200
Mississippian Elkton	8,500
Shunda	8,600

INNISFAIL
Pay: Leduc (D3), 8,550 ft.

Cost averages: Footages price $7.25
Day: with pipe $1,025; without pipe $950

Normal Rig-Time Distribution

% on ft. rate	83	Total days	60
% on day rate	17	Total bits	45

Equipment
Fuel: Diesel. Water: Wells.
Supply centers: Edmonton; Calgary.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	600	500
Oil string	5½-7	TD	600

Avg. Formation Tops (Drlg. depth, ft.)

Leduc reef	8,500

Remarks: Slow drilling below 6,000 ft.

KAYBOB
Pay: Beaverhill Lake, 9,900 ft.

Approx. cost of well: Dry hole $120,000
Flowing $180,000

Cost averages: Footage price $7.00
Day: with pipe $1,100; without pipe $1,050

ACTIVE FIELDS

Normal Rig-Time Distribution

% on ft. rate	80	Total days	50
% on day rate	20	Total bits	37

Water: Lake. Terrain: Muskeg.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	1,500	1,200
Oil string	5½	9,900	1,400

Typical Mud Program

Gel, water with 5-10% oil

Avg. Formation Tops (Drlg. depth, ft.)

Mississippian	6,100
Devonian D-1	7,300
Beaverhill Lake	9,500
Slave Point	9,800

KEYSTONE AREA

Pay: Cardium, 4,200 ft.

Approx. cost of well: Dry hole $40,000
Flowing $67,000 On pump $78,000

Cost averages: Footage price $3.25
Hourly: with pipe $38; without pipe $35

Normal Rig-Time Distribution

% on ft. rate	63	Total days	11
% on hr. rate	37	Total bits	9

Equipment

Fuel: Diesel. Water: Surface.
Supply center: Drayton Valley.
Terrain: Rolling muskeg.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	600	300
Oil string	5½	4,200	300

Typical Mud Program

Gel, sacks	60
Baroid, sacks	250
Tannese, sacks	5
Carbonox, sacks	20
Lime, sacks	4
Caustic soda, sacks	3

Avg. Formation Tops (Drlg. depth, ft.)

Basal Belly River	3,100
Lea Park	3,150
Colorado	3,600
Cardium sandstone	4,100

MEDICINE HAT

Pay: Medicine Hat sand, 1,500 ft.

Approx. cost of well: Dry hole $4,500
Flowing (gas) $12,000

Cost averages: Footage price $2.00
Per hour: with or without pipe $22

Normal Rig-Time Distribution

% on ft. rate	100	Total days	3-5
% on hr. rate		Total bits	2

Equipment

Fuel: Diesel.
Water: Haul from local pond.
Supply center: Medicine Hat (25 miles).
Terrain, roads: Rolling; roads fair.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	7	250	85
Oil string	4½	1,500	200

Avg. Formation Tops (Drlg. depth, ft.)

Milk River sandstone	1,000
Colorado shale	1,350
Medicine Hat sandstone	1,400

NORMANDVILLE

Pay: Leduc (D-3), 6,800 ft.

Approx. cost of well: Dry hole $85,000
Flowing $115,000 On pump $130,000

Cost averages: Footage price $6.25
Hourly: with pipe $40; without pipe $36

Normal Rig-Time Distribution

% on ft. rate	75	Total days	40
% on hr. rate	25	Total bits	35

Equipment

Supply center: Valleyview, Alta.
Terrain, roads: Flat farm land. Roads good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	600	450
Oil string	5½	6,650	1,000

Typical Mud Program

Aquagel, lb.	47,500
Caustic, lb.	2,000
Tannex, Quebracho, lb.	3,500
Bicarb, lb.	2,500
Anhydrox, Antigyp, sacks	125

Avg. Formation Tops (Drlg. depth, ft.)

Bluesky	1,250
Mississippian	3,250
Wabamun D-1	5,450
Winterburn D-3	6,300
Leduc D-3 Reef	6,650

OLDS

Pay: Basal quartzite, 8,100 ft.

Cost averages: Footage price 7.00
Day: with pipe $1,100; without pipe $1,050

Normal Rig-Time Distribution

% on ft. rate	67	Total days	54
% on day rate	33	Total bits	40

Equipment

Fuel: Diesel. Water: Wells.
Supply centers: Edmonton; Calgary.
Terrain, roads: Flat. No moves during spring thaw.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	750	600
Oil string	5½-7	TD	500

Avg. Formation Tops (Drlg. depth, ft.)

Basal quartzite	8,050

PEMBINA

Pay: Cardium, 5,800 ft.

Approx. cost of well:
Flowing $58,000 On pump $62,250

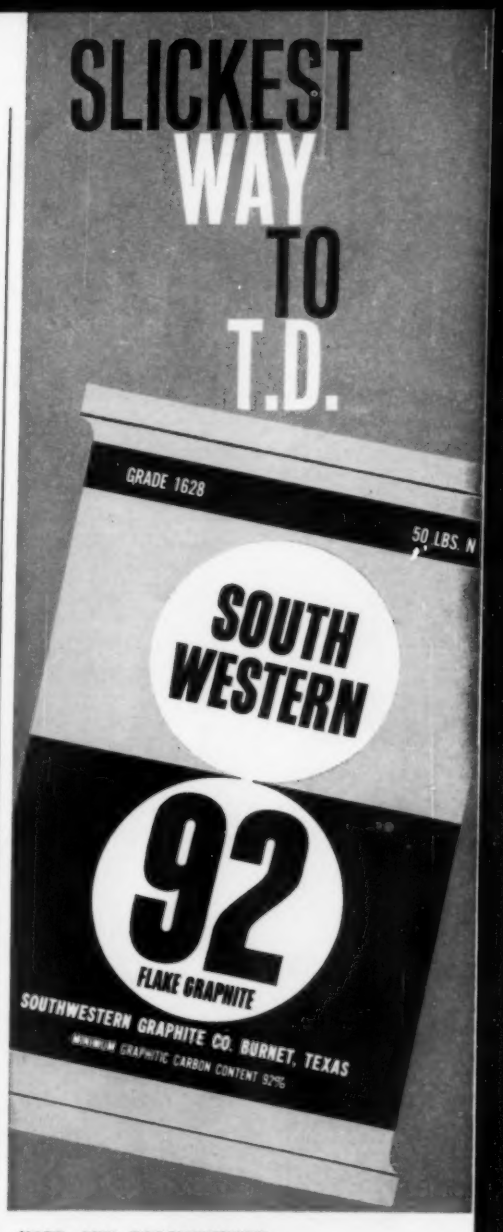
Cost averages: Footage price $2.85
Day: with pipe $888; without pipe $816

Normal Rig-Time Distribution

% on ft. rate	97	Total days	10
% on day rate	3	Total bits	7

Equipment

Fuel: Diesel. Water: Wells.
Supply center: Drayton Valley.
Terrain, roads: Flat; partially muskeg. Operator builds roads.



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ACTIVE FIELDS

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	600	400
Oil string	5½	5,800	300

Typical Mud Program

Barites, sacks	100
Gel, sacks	25

Avg. Formation Tops (Drlg. depth, ft.)

Belly River	4,200
Lea Park	4,500
Cardium zone	5,570
Cardium sand	5,650

Saskatchewan

CARNDUFF

Pay: Midale beds (Charles); Frobisher beds (Mission Canyon), 4,200 ft.

Approx. cost of well: Dry hole $35,000
Flowing $57,000 On pump $65,000

Cost averages: Footage price $3.67
Hourly: with pipe $34; without pipe $31

Normal Rig-Time		Distribution	
% on ft. rate	80	Total days	12
% on hr. rate	20	Total bits	7

Equipment

Fuel: Diesel. Water: Local surface.
Supply center: 10 miles.
Terrain; roads: Level; dirt roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	600	400*
Oil string	5½	4,200	350**

*3% calcium **4% gel.

Note: Most operators set casing through the producing formations and perforate the desired zone.

Typical Mud Program

Gel, sacks	50
Bicarb, lb.	200
SAPP, lb.	300
Plaster, lb.	1,500
Starch, lb.	2,500
Preservative, lb.	500

Avg. Formation Tops (Drlg. depth, ft.)

Second White Specks	2,305
Blairmore	2,816
Vanguard	3,244
Shaunavon/Gravelbourg	3,428
Watrous	3,784
Red beds	3,918
Midale beds (Charles)	4,042
Frobisher beds (Mission Canyon)	4,097

GLEN EWEN

Pay: Midale limestone of Mississippian formation, 4,200 ft.

Approx. cost of well: Dry hole $25,000
Flowing $50,000 On pump $60,000

Cost averages: Footage price $2.75-$3.00
Day: with pipe $800; without pipe $750

Normal Rig-Time		Distribution	
% on ft. rate	80	Total days	10
% on day rate	20	Total bits	6-8

Equipment

Fuel: Diesel. Water: River.
Supply center: Estevan.
Terrain: Rolling prairie.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	500	375
Oil string	5½	4,200	200

Typical Mud Program

Bentonite, lb.	3,000-6,000
Drilling plaster, lb.	1,500-2,000
Starch, lb.	3,000-3,500
Preservative, lb.	600-800
Bicarb, lb.	300
SAPP, lb.	300

Avg. Formation Tops (Drlg. depth, ft.)

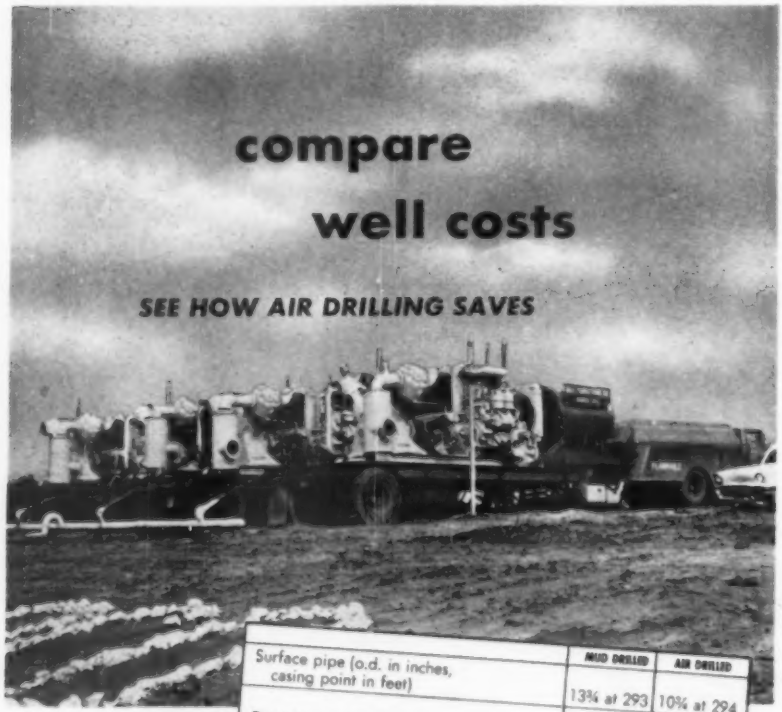
Blairmore	2,900
Jurassic	3,300
Watrous anhydrite	3,900
Mississippian	4,100
Midale limestone	4,100

STEELMAN

Pay: Central Midale beds, 4,650 ft.

Approx. cost of well: Dry hole $20,000
Flowing* $42,000 On pump* $51,000
*Plus tank battery.

Cost averages: Footage price* $2.60
Hourly: with pipe $31; without pipe $33
*Includes pits, fuel, water, and all drilling mud.



Drilling costs of these 2 wells prorated to 3,000 ft. show air drilling savings.

	MUD DRILLED	AIR DRILLED
Surface pipe (o.d. in inches, casing point in feet)	13¾ at 293	10¾ at 294
Total days to 3,000 ft. depth		Core 2,794
Total bits below surface to 3,000 ft. depth	16	4
Feet per bit	11	2
Total depth of hole (ft.)	272	1,500
Mud costs, prorated for 3,000	7,257	2,900
Air costs	$20,000	0
Total costs of mud for well	0	$2,655
Total costs of well, incl. testing, coring, etc.	$47,515	0
Est. costs of first 3,000 ft. of hole	$280,000	$29,400
	$116,000	$30,400

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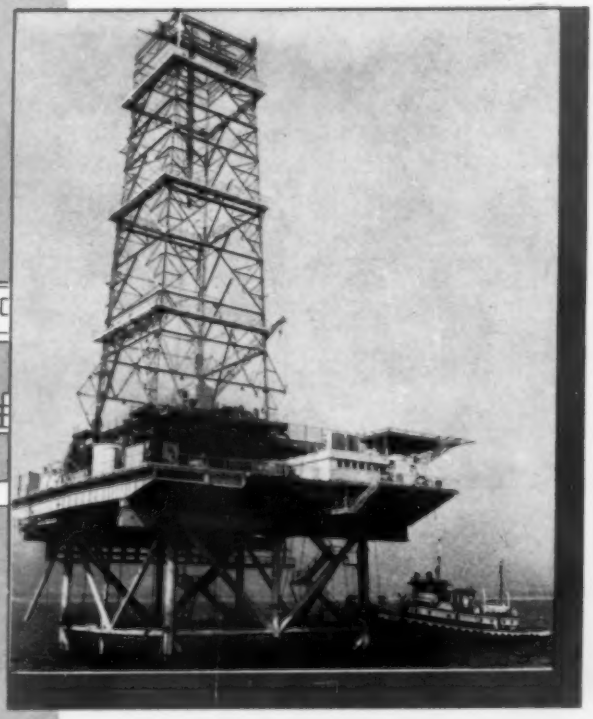

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NATIONAL STEEL AND SHIPBUILDING CORPORATION

ASK NASSCO

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San Diego, California

ACTIVE FIELDS

Normal Rig-Time		Distribution	
% on ft. rate	90-95	Total days	10
% on hr. rate	10- 5	Total bits	8

Equipment

Fuel: Butane.
Water: Farmers' stock tanks.
Supply center. Estevan (30 miles).
Terrain, roads: Flat. Poor gravel roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	600	300
Oil string	5½	4,700	225

Typical Mud Program

Water to 4,000 ft., then convert to gyp base mud for drilling red beds and anhydrite. Reduce water loss to drill pay zone.

Avg. Formation Tops (Drlg. depth, ft.)

Jurassic	3,450
Red beds	4,350
Mississippian	4,500
Midale pay	4,600

WEYBURN

Pay: Midale, 4,520 ft.

Approx. cost of well: Dry hole $38,000
Flowing $80,000 On pump $91,000

Cost averages: Footage price $3.75
Day: with pipe $800

Normal Rig-Time		Distribution	
% on ft. rate	80	Total days	17
% on day rate	20	Total bits	8

Equipment

Fuel: Diesel. Water: River.
Supply center: Weyburn, Sask.
Terrain, roads: Good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	340	225
Oil string	7	4,504	240

Typical Mud Program

Gel, lb.	2,000
Plaster, lb.	1,500
Starch, lb.	2,400

Avg. Formation Tops (Drlg. depth, ft.)

Watrous	4,072
Charles	4,352
Midale	4,352
Mission Canyon	4,413

BOOK

UCLA LAW REVIEW, OIL AND GAS ISSUE, Vol. 5, No. 3. Published by School of Law, University of California, Los Angeles 24. $1.50.

This issue of the quarterly UCLA law Review has been entirely devoted to the field of oil and gas law.

The issue contains three articles which were originally presented at a symposium conducted by the California Committee on Continuing Education of the Bar. These articles have been augmented and footnoted by their authors, and an additional article by a Los Angeles practitioner has been added. Also included are extensive student materials exploring most recent developments in the oil and gas area.

Nelson Refinery Construction Index

Appears in the engineering section in the first issue each month.
Compiled by W. L. Nelson, petroleum refinery consultant, Tulsa.
The index was explained October 1, 1956 (page 110), as well as the Indexes of Individual Items of Equipment that appear on the Costimating page in the first issue of the months of January, April, July, and October.

Index (1946 = 100)

	1950	1954	1955	1956	1957	June 1958
Pumps, compressors, etc.	138.2	166.5	172.2	192.0	206.7	213.6
Electrical machinery	134.9	160.0	162.5	175.0	188.9	193.3
Internal-combustion engines	126.0	150.5	153.2	164.0	173.9	178.4
Instruments	127.8	154.6	162.9	182.1	187.4	193.5
Heat exchangers	140.0	171.7	156.8	190.7	203.6	174.2
Misc. equipment average	*126.2	160.7	161.5	180.5	192.1	190.6
Materials component	149.5	174.6	176.1	190.4	201.9	202.0
Labor component	144.0	183.3	189.6	198.2	208.6	220.4
Nelson construction index	146.2	179.8	184.2	195.3	205.9	213.0

*Used in computing the Nelson Index until April 1952. This is slightly different from the average of the Miscellaneous Equipment Items shown above.

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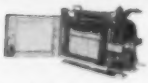
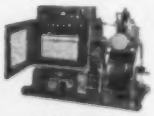

1,000 ft. Unit

2,000 ft. Unit

3,000 ft. Unit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BY W. L. NELSON, Technical Editor and Petroleum Consultant

COSTimating

Itemized Cost Indexes

THE COST INDEXES may be used to convert prices at any date to prices at other dates by ratios of the cost indexes of the same date. Itemized indexes are published each quarter (first weekly issues of January, April, July, and October). In addition, the Nelson Construction Cost Index is published in the first issue each month of The Oil and Gas Journal.

	1949	1952	1954	1956	1957	May 1958	References*	Index for earlier years (The Oil and Gas Journal) in Costimating and Questions on Technology issues
Operating costs (based on 1956 as 100.0):								
Power, electric, industrial	¶97.6	¶97.9	¶98.5	100.0	¶101.3	103.2	Code 540-03	
Fuel, residual	66.0	81.0	86.5	100.0	117.6	92.1		No. 4—Mar. 17, 1958
Gulf cargoes	69.5	78.3	85.9	100.0	123.8	105.1		No. 4—Mar. 17, 1958
N. Y. barges	69.6	84.9	82.6	100.0	112.3	93.8		No. 4—Mar. 17, 1958
S. Pedro bunkers	76.9	79.8	84.3	100.0	129.2	110.6		No. 4—Mar. 17, 1958
Oklahoma	51.2	57.1	62.0	100.0	105.3	59.1		No. 4—Mar. 17, 1958
Fuel, natural gas, wellhead	58.3	72.2	88.9	100.0	101.8	118.3	Code 531-01	
Industrial chemicals	80.1	95.0	96.9	100.0	101.9	102.1	Code 6-1	
Phosphoric acid	86.7	93.9	96.6	100.0	100.9	103.4	Code 6-11-07	
Sulfuric acid	76.1	89.5	100.0	100.0	100.0	100.0	Code 6-11-09	
Ammonia	104.8	94.6	103.0	100.0	98.3	101.8	Code 6-11-13	
Lime		87.7	92.0	100.0	106.4	104.0	Code 6-11-29	
Sodium carbonate	76.7	84.5	92.9	100.0	104.3	104.3	Code 6-11-65	
Sodium hydroxide	73.5	80.6	90.9	100.0	103.6	115.7	Code 6-11-69	
Sodium phosphate	85.3	92.0	95.5	100.0	101.1	104.6	Code 6-11-71	
Furfural		93.6	100.0	100.0	100.0	100.0	Code 6-12-63	
MEK, drums		94.5	94.5	100.0	105.2	106.9	Ch. & E. News	
Phenol		110.6	90.4	100.0	103.2	103.2	Code 6-12-83	
TEL	95.9	105.4	102.8	100.0	101.5	99.4	Supplier	
Operating labor (wages)	69.5	81.5	88.7	100.0	103.9	100.5	Employ. & Earn.	No. 55—Nov. 3, 1949
Productivity	85.5	90.2	97.1	100.0	98.0	97.6	Employ. & Earn.	Sept. 24, 1956§
Construction wages (1946 = 100):								
Skilled construction	133.9	157.9	174.6	187.3	196.3	202.4	Eng. News Record	No. 55—Nov. 3, 1949
Common labor	140.4	168.2	192.1	209.2	221.0	233.4	Eng. News Record	No. 55—Nov. 3, 1949
Refinery construction	137.1	163.1	183.3	198.2	208.6	217.9		No. 61—Dec. 15, 1949
Equipment or materials (1946 = 100):								
Arc-welding machinery	130.5	151.3	158.4	180.2	186.6	194.5	Code ‡11-76	May 2, 1955§
Boilers, tanks, and sheet metal	†134.8	†153.4	147.3	168.0	176.3	174.9	Code 10-72	Apr. 21, 1952§
Building materials (nonmetallic)	151.2	134.8	143.6	154.0	159.9	161.2	Code ‡13	No. 22—Mar. 17, 1949
Brick-building	127.7	140.6	144.7	159.2	161.3	162.2	Code 13-41	No. 20—Mar. 3, 1949
Brick—fireclay	139.8	167.1	193.1	218.1	232.7	235.6	Code 13-42	May 30, 1955§
Castings (foundry products)	150.5	168.0	181.1	204.7	220.5	225.8	Code 10-15	No. 46—Sept. 1, 1949
Clay products (structural, etc.)	126.0	145.8	159.1	176.9	184.0	185.9	Code 13-4	No. 20—Mar. 3, 1949
Concrete—ingredients	123.7	132.7	142.1	153.3	159.7	163.2	Code 13-2	No. 22—Mar. 17, 1949
Concrete—products	121.7	132.6	138.5	144.9	149.0	151.4	Code 13-3	
Electrical machinery	130.9	152.4	159.9	175.0	¶188.6	193.0	Code ‡11-7	May 2, 1955§
Motors and generators	128.7	154.6	157.7	169.6	181.2	186.5	Code ‡11-73	No. 31—May 19, 1949
Switchgear	132.3	161.4	171.2	194.9	¶212.0	219.8	Code ‡11-75	May 2, 1955§
Transformers	129.7	148.0	161.9	175.4	188.0	186.6	Code ‡11-74	No. 31—May 19, 1949
Engines (composite)	124.8	146.5	150.5	164.0	173.9	178.2	Code ‡11-54	No. 36—June 23, 1949
Exchangers	133.0	165.8	¶171.7	¶190.7	203.6	184.6	Manufacturer	No. 2—Oct. 28, 1948
Copper base		175.3	¶156.8	198.8	191.4	172.6	Manufacturer	
Steel		152.3	¶190.7	178.6	213.2	194.1	Manufacturer	
Fans and blowers	152.2	183.7	192.6	222.4	236.1	241.5	Code ‡1-47	Feb. 17, 1948§
Hand tools	134.0	155.1	173.8	200.3	214.3	224.2	Code 10-42	June 27, 1955§
Instruments (composite)	123.1	146.2	154.6	182.1	187.4	193.5	Manufacturer	No. 34—June 9, 1949
Flowmeter (mechanical)	109.2	132.3	161.6	203.3	203.3	203.3	Manufacturer	No. 34—June 9, 1949
Flowmeter (air control)	132.4	160.5	179.6	203.9	208.2	213.3	Manufacturer	No. 34—June 9, 1949
Flowmeter (remote)	130.2	155.2	146.5	170.2	171.2	173.2	Manufacturer	No. 34—June 9, 1949
Potentiometer, 6-point	125.8	151.5	167.2	211.8	230.9	240.7	Manufacturer	No. 34—June 9, 1949
Potentiometer, air control	131.6	144.9	150.5	192.3	204.6	212.6	Manufacturer	No. 34—June 9, 1949
Pressure controller recorder	130.2	158.4	166.3	187.1	189.3	200.0	Manufacturer	No. 34—June 9, 1949
Pressure gage	100.0	108.6	108.6	119.2	119.2	119.2	Manufacturer	No. 34—June 9, 1949
Thermometer (recording)	118.6	149.4	152.8	170.2	171.8	179.7	Manufacturer	No. 34—June 9, 1949
Control valve	129.8	155.5	162.0	180.9	187.8	199.3	Manufacturer	No. 34—June 9, 1949
Lumber (composite)	165.3	203.2	197.8	214.5	201.8	196.8	Code 8-1	No. 7—Dec. 2, 1948
Southern pine	157.7	191.2	181.2	195.0	187.6	183.5	Code 8-12	No. 7—Dec. 2, 1948
Other soft woods	203.9	248.5	252.7	266.5	257.6	250.2	Code 8-13	No. 7—Dec. 2, 1948
Machinery—general purposes	131.9	151.8	159.9	183.8	196.5	199.2	Code 11-4	Feb. 17, 1949§
Machinery—construction	136.0	157.5	165.9	187.4	199.4	208.7	Code 11-2	
Machinery—oil-field	†132.9	†149.9	†161.9	†179.3	193.2	189.8	Code 11-51	Oct. 10, 1955§
Paints—prepared	142.8	155.7	159.0	169.2	178.1	181.0	Code 6-21	May 16, 1955§
Pipe, sewer	†119.3	136.9	140.1	160.5	168.0	169.6	Code 13-45	No. 22—Mar. 17, 1949
Pipe, black iron	152.2	179.0	195.0	233.0	256.1	263.5	Code 10-14-56	No. 19—Oct. 15, 1956
Pipe, 6-in. line	†152.0	174.0	200.5	241.2	268.3	275.3	Code 10-14-58	May 4, 1957§
Pumps, air compressors, etc.	135.9	155.6	166.5	192.0	206.7	213.6	Code ‡11-41	No. 29—May 5, 1949
Steel (iron and steel)	143.3	168.5	179.6	209.0	224.5	224.5	Code 10-1	No. 61—Dec. 15, 1949
Steel—finished steel	173.8	170.0	187.1	212.4	232.5	237.9	Code 10-14	July 25, 1955§
Plate	142.1	163.1	187.0	215.9	241.8	249.2	Code 10-14-26	Mar. 4, 1957§
Structural shapes	151.2	176.2	193.4	219.1	252.2	258.6	Code ‡10-14-31	No. 18—Feb. 17, 1949
Seamless tubes, 2-2¼ in.	140.9	168.8	199.4	235.5	265.4	273.5	Code 10-14-61	Sept. 5, 1955§
Valves and fittings	†132.9	190.8	197.1	231.9	243.4	241.3	Code ‡11-49 (10 items)	No. 46—Sept. 1, 1949
Nelson Refinery Construction (1946)	139.6	163.6	179.8	195.3	205.9	211.7		No. 61—Dec. 15, 1949
Nelson Ref. Operation (1956)	68.2	80.5	88.7	100.0	107.0	103.0		No. 2—Mar. 3, 1958
Nelson Ref. Process Oper. (1956)	71.3	82.2	88.4	100.0	108.1	102.5		No. 2—Mar. 3, 1958

*Code refers to the revised index code number of the Bureau of Labor Statistics, U. S. Department of Labor, "Wholesale Prices."

†Estimated base value for 1946.

‡Not exactly the same items as those published before July 7, 1952.

§Questions on Technology, The Oil and Gas Journal. ¶Revised.

Operating labor in processing plants

BY W. L. NELSON
Technical Editor and
Petroleum Consultant

THE LITERATURE reveals great variations in the number of operators thought to be necessary for the operation of processing units (see Processing Costimating No. 26, September 15, 1958, p. 244). However, the complexity of the process can be assessed in some degree from the following factors or jobs that are ordinarily weighted as one, but may be weighted as much as three, particularly with respect to such items as manual labor:

- 1 Pipe still (or burners)
- 1-2 Towers (atmospheric)
- 1 Fractionators or pressure towers
- 1 Reactor, contactor or extractor
- 1 Extremes in pressure, temperature or corrosion
- 1 Compressor or refrigeration
- 1 Major control room
- 1-3 Manual labor
- 1-2 Machinery, filters, etc.
- 0.5-1 Tending, miscellaneous, etc.

Each job or factor represents one man per shift (including supervision) except that small refiners employ somewhat fewer men than large or major refiners as follows:

Small refiners,
men per shift = jobs less 1

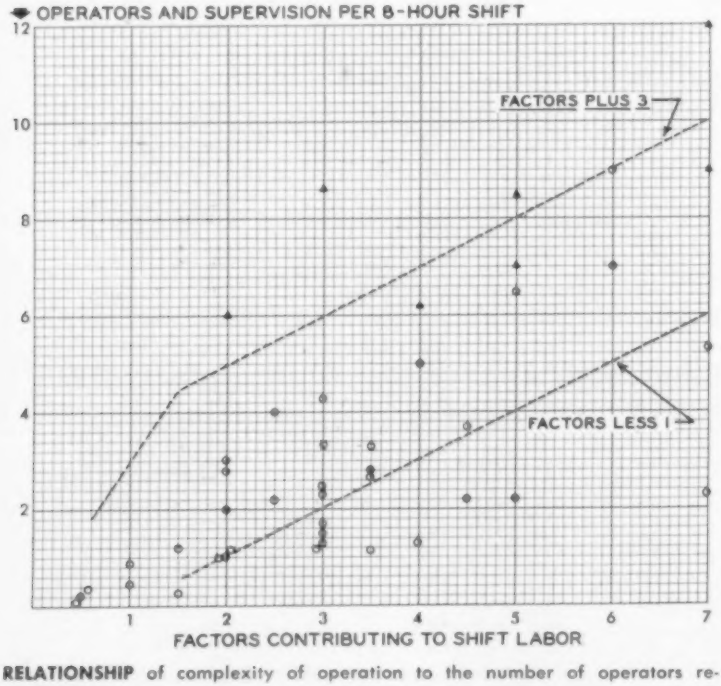
Major refiners,
men per shift = jobs plus 3

This is indicated in Fig. 1. The amount of supervision thought to be necessary also varies widely. The average of 26 references is 13.3% of the combined operating labor and supervision but values range from 5.9 to 40%.

Likewise, maintenance labor and its supervision is about two-thirds of the operating labor and supervision. This obviously does not include all maintenance labor because in the entire refinery organization, maintenance is larger than operational labor by 63 to 83%.

Although theoretically a large unit can be operated with the same number of men as smaller units, it is evident that large companies employ more operators and supervisors per barrel of throughput than small operators.

Note that several processes may be grouped together with a common operating staff.



RELATIONSHIP of complexity of operation to the number of operators required. Fig. 1.

TABLE 1—APPROXIMATE OPERATING AND SUPERVISORY LABOR —MEN PER 8-HOUR SHIFT*

	Small units	Major operators
Alkylation	3	7
Asphalt manufacture	2-4	5-7
Contacting (clay)	2	5
Cracking:		
Catalytic	5	9
Coking	‡4	‡8
Reforming	†2	†6
Thermal	3	7
Visc. breaking	†2	†6
Deasphalting	1.5	5
Dehydrogenation	4	8
Deoiling or sweating	1.5	5
Drying	†0.5	†3
Desalting	0.03	0.3
Desulfurization (gas)	†0.5	†4
Dewaxing:		
Centrifuge	2	6
Filter press	2	6
Solvent	3	7
Distillation:		
Atmospheric	1	5
Pressure	†2	†6
Topping	†1.5	†5
Vacuum flash	†1	†5
Vacuum	†1.5	†5.5
Ethylene (gas cracking)	5	9
Extraction	3	7
Gas recovery	†2	†6
Hydrotreating	2	6
Isomerization	2-4	6-8
Percolation (lubes)	1	5
Polymerization	†2	†6
Reforming (catalytic)	3	7
Sulfur manufacture	‡3	‡7
Treating:		
Acid	1	4
Light oil	0.5-1	3-5
Sweetening	0.5	5
Wax molding	‡2-5	‡7-9

*Supervision is about 12½% of total operating and supervision. Maintenance labor and supervision is about two-thirds of operating labor and supervision.

†If conducted as a separate process.

‡Is a function of size because of manual labor.

MR. H. S. M. BURNS,

President and Chairman of the Executive Committee of the Board of Directors, Shell Oil Company

". . . no factor is more essential . . ."

"From exploration through marketing, the success of oil industry operations depends largely on what the military men call logistics—making sure that what you want is where you want it when you want it.

"Most of us oil men in the United States take it for granted that such matters can be easily handled. Getting supplies and equipment ordinarily involves no more than reaching for the telephone. The reason is that the suppliers do such a good job of maintaining warehouses and effecting deliveries. I suspect that many of us become so used to this that we don't appreciate it properly.

"I learnt appreciation the hard way some years ago when I was involved in developing new oil fields in nearly inaccessible tropical jungle, hundreds of miles from the comforts of civilization. We surely missed being able to handle our supply problems by the phone call treatment.

"The oil industry is complex. Its future success will depend on continued performance by all its members. And no factor is more essential or more likely to contribute to that end than the vigorous, progressive companies that supply petroleum equipment."

P.E.S.A.*

* PETROLEUM EQUIPMENT SUPPLIERS ASSOCIATION

PROUD TO BE PART OF A PIONEERING INDUSTRY

PETROLEUM EQUIPMENT SUPPLIERS ASSOCIATION

To get more oil out of the ground, production men are eying . . .

Two new recovery processes

BY NORMAN J. CLARK
Core Laboratories, Inc., Dallas

MANY new recovery methods are being tested both in the laboratory and the field by the industry today as a part of the over-all effort to increase oil recovery. Of these methods, two general processes appear to have considerable merit. They are (1) miscible drive[1 2 3 4 5] and (2) combustion drive.[6 7 8]

Miscible Drive

Oil cannot produce itself except to a very small degree. The bulk of the common energy that is available to produce oil by primary means is gas and water under high pressures in the native reservoir rock. The energy in these compressed fluids is used to drive oil from the reservoir by allowing reservoir pressure to drop and these fluids to expand into the reservoir rock, displaying the oil to the well bores.

Conventional pressure maintenance and secondary-recovery methods merely involve the injection of additional quantities of gas or water into reservoirs where the primary volumes of these fluids in the reservoir were small. Even under the best primary or conventional secondary method of operations the per cent of original oil which can be recovered is small.

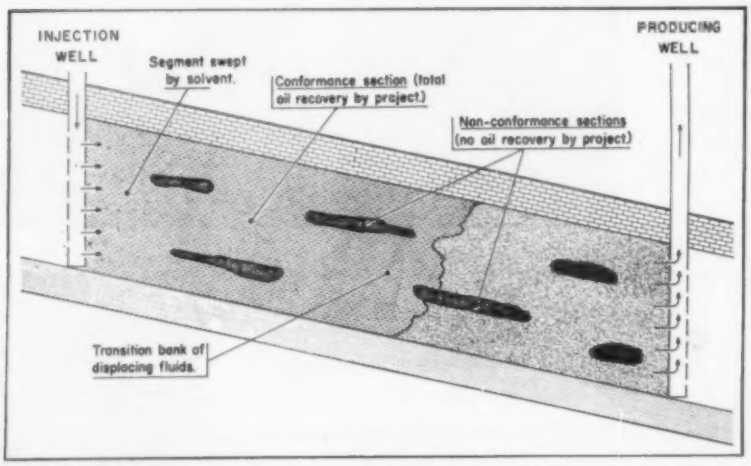
Engineers have recognized for many years that capillary forces present in a porous rock are responsible for the rock holding the oil back and preventing its displacement even under the best natural drive or conventional secondary-recovery conditions. The capillary forces that tend to retain the oil are not present if the oil is pushed by another oil or some other liquid that is miscible with oil.

By using a solvent which is miscible in the oil as a displacing material, therefore, the oil in a reservoir can be displaced from the rock with a high degree of efficiency. This has been known for many years, and solvents have been used to clean cores of their residual oil for core-analysis measurements.

The oil-miscible solvents, however, are expensive and for many years the thought was that miscible displacement, though efficient, would be uneconomic because of the cost of great quantities of materials necessary to replace all of the oil produced. (Fig. 1).

The present-day miscible-drive methods use the oil-miscibility principle. The methods are engineered to accomplish all the good features of miscible displacement and yet leave gas, or some other relatively inexpensive driving material, in the reservoir in the place of the displaced oil (Fig. 2). The process is accomplished by using a minimum amount of solvent as a buffer or scavenger ahead of injected gas. The solvent must stay between the oil and gas and must be miscible in both the oil and gas at all times.

Since injection and possible loss of great quantities of marketable materials even at best are involved in the process, and since many factors influence miscible-drive operations, it follows that any project of this nature will require much greater and more careful engineering considerations than is usually given to those conventional operations involving injection of less valuable or nonmarketable materials.


INJECTION WELL
PRODUCING WELL
Segment swept by solvent.
Conformance section (total oil recovery by project)
Non-conformance sections (no oil recovery by project)
Transition bank of displacing fluids.

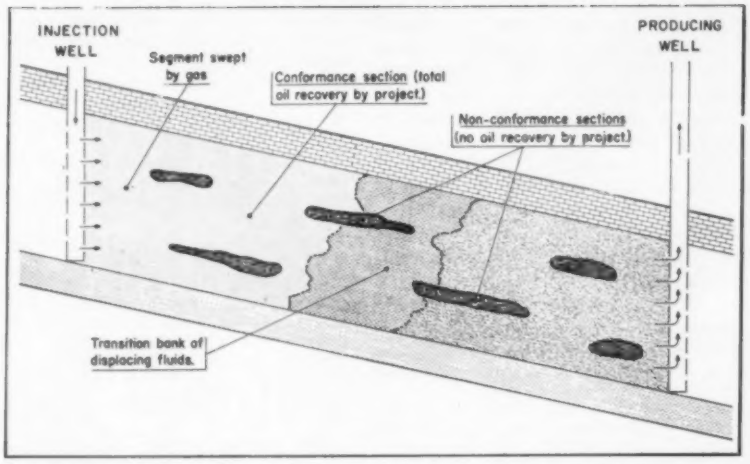
HIGH RECOVERY obtained by displacing oil with solvent only. Fig. 1.

Combustion Drive

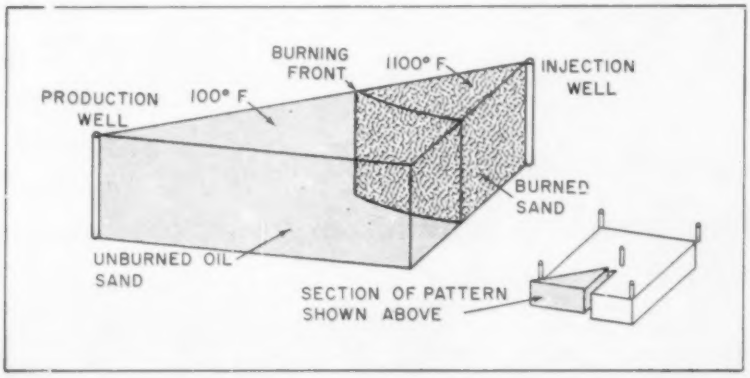
Combustion drive or in situ combustion is an oil-recovery process in which part of the oil in place is burned in the reservoir and energy from this combustion is used to drive the remaining oil to the producing well.

The process involves igniting the reservoir oil in a well bore and injecting air so that the burning zone and the heat moves out into the reservoir. Raising the temperature of the reservoir reduces the viscosity of the oil so that the oil will flow more readily.

The oil ahead of the burning front


INJECTION WELL
Segment swept by gas
Conformance section (total oil recovery by project)
Non-conformance sections (no oil recovery by project)
PRODUCING WELL
Transition bank of displacing fluids.

ECONOMIC RECOVERY obtained by displacing oil with solvent and inexpensive gas. Fig. 2.



SCHEMATIC DIAGRAM of a five-spot field test of in situ combustion method, showing temperature distribution. Fig. 3.

moves both by flow driven by combustion products and by distillation from the heat, leaving residual oil or coke as the fuel to keep the burning process operating. After the burning front has moved through the reservoir little or no residual oil is left in the portion of the reservoir contacted. (Fig. 3).

A considerable amount of laboratory work and a number of field trials have been undertaken to prove the combustion-drive process, and to date encouraging results have been obtained. The process, however, has been found to be extremely complicated. This occurs because the complexities involved in the combustion process itself compound the complexities present in the geologic configuration of the reservoir.

Important factors that influence the process are oxidation characteristics of the crude oil; distillation properties of the crude oil; coking behavior of the oil; combustion temperature of the operation; heat capacity of the rock, fluids, and gases injected; heat loss to beds above and below the burning stratum; movement of heat through the reservoir; density of the fluids and gases so that gravity effects can be estimated; irregularity of the reservoir porosity and permeability; oil saturation of the zone being burned; relative permeability of the reservoir rock to oil, gas, and water ahead of the burning zone; and the portion of the reservoir contacted by the burning zone.

In contrast to miscible drive which has found its best application in deep high-pressure reservoirs with high-gravity oil, the combustion drive process is being tested in shallow low-pressure reservoirs with low-gravity, viscous oils.

The combination of these two new processes in the hands of the industry should permit great strides to be made toward improving the over-all average oil-recovery expectancy.

Today, the key personnel in the industry who can exploit oil reservoirs for greatest efficiency in oil recovery are the development geologists (sometimes called reservoir, subsurface, or exploitation geologists), reservoir engineers, and field production engineers. This does not in a general sense include exploration geologists or drilling engineers. Fig. 1 shows the interrelation of the exploitation team and individual duties.

Development and delineation of the reservoirs are accomplished by the application of a combination of geologic and engineering principles, each complementing the other. When the two complementary sciences are separated, the development of the reservoir is generally less efficient and will possibly result in improperly located and completed wells, waste in drilling and completion costs, excessive drilling of wells, and lowered efficiency of oil recovery through poor reservoir-drainage pattern.

Planning production operations to recover the greatest portion possible of the oil found initially in the reservoir primarily concerns the reservoir engineer. The production of the reservoir is concerned with economics as well as over-all recovery of hydrocarbons from the reservoir; yet both are intimately associated. Increased production rates increase income while in many cases adjusted production rates increase recovery. Obtaining maximum economic recovery, therefore, is the crux of the production problem.

Frank Willibrand[9] stated that "Engineers are a part of management in our business, a vital part. Our domestic oil industry, despite its many present problems, will remain strong and competitive only if we contrive to bring in keen, inquisitive, scientific minds for employment in our oil find-

About the author . . .

N. J. CLARK

The percentage of oil to be recovered in the future from presently known reservoirs and reservoirs yet to be found is an item of critical interest. The author believes that if the industry can properly evaluate the areas of endeavor that influence oil recovery and continue to improve, recovery expectancy will be boosted. The author was with Humble Oil & Refining Co. for 14 years before assuming his present position of assistant manager of the engineering and consulting department, Core Laboratories.

ing and oil production activities in a climate conducive to the continuing growth of the individuals with these sharp minds. Operating management will in the future use its production and reservoir engineers much more intensely than it does now, for our very existence depends on this."

This places a great responsibility upon the shoulders of management because managing an enterprise involving so many specialists as are included in reservoir development and production makes it mandatory that management be well versed at least in the over-all technological aspects of the business.

Reservoir engineering is still considered by many managers to be a complex hodgepodge of highly technical scientific principles. As more and more managers are looking closer into the work, they are finding that its complexity is brought about principally because of the extremely large area covered and that actually it involves a practical use of many basic fundamentals.

Probably the greatest difficulty involved in properly managing and carrying out reservoir engineering work in a company is caused by not being able to see the reservoir directly as it is being produced but having to recognize what is happening through the interpretation of data made by various instruments.

A paper dealing with problems of oil recovery such as this would not be complete without a word about the "quickie" reservoir study. Management quite frequently finds itself needing reservoir answers of a broad scope to guide decisions on operations of considerable magnitude.

All too often a decision must be made fast where an adequate reservoir study cannot be made within the available time limit. The decision is then shaped around a study of the so-called "quickie" type utilizing rules of thumb and approximations and frequently without adequate reservoir data.

Management's insurance against this can only be through proper planning and obtaining reservoir data and maintaining up-to-date engineering studies of its reservoirs.

Gathering of data while drilling a well is frequently costly. Passing up reserves because the drilling was not accompanied by the proper obtainment of data, however, is much more expensive. Failing to obtain data during drilling that are needed to exploit the secondary oil is also quite expensive in its way.

Here, of course, the engineer and geologist have the responsibility of advising management. Management should follow up on this very closely and economize in necessary services through better planning of their data gathering program. In this way, adequate data can still be obtained at savings in cost through elimination of much unnecessary data and taking of only the data that fits the planned program. A properly planned "Key Well Program" of coring, logging, and testing will accomplish this at minimum cost.

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Latest API Recommended Practice for

Determining productivity indexes

IN AN announcement dated June 1958, the American Petroleum Institute has released API RP 36, Recommended Practice for Determining Productivity Indexes, as follows:

Surface equipment

1. Christmas trees should be so designated that a subsurface pressure gage can be run without shutting in the well.

2. Adequate equipment should be installed to measure accurately all oil, gas, and water production. (Short flow lines are desirable to obtain accurate hourly gages.)

3. Measurements of oil, was, water, and pressures should be synchonized.

Production rate

1. Select a production rate such that the difference between the subsurface pressure measured while the well is producing and the static pressure can be determined accurately.

2. Produce the well without changing size of choke throughout the test. (Similarly, no changes should be made on pumping wells.)

Recommended procedure

Determine productivity index as follows:

1. With well on test rate of production, run subsurface pressure gage to run depth (preferably at midperforation point) and allow sufficient time for a flowing pressure measurement.

2. During flow, hourly gages should be taken and surface pressures noted, to indicate when the well is becoming stabilized.

3. The test should be extended several hours beyond apparent stabilization.

4. If the well does not stabilize, the test should be extended as long as practical, or at least until sufficient data have been obtained to determine the rate of decline of the productivity index.

5. Determine static pressure as follows:

After obtaining flowing pressure as outlined in (1), shut well in for a buildup test to obtain static pressure.

6. Determine buildup pressure as follows:

In order to assure proper determination of points of deflections in the buildup curves, pressures should be recorded or read at frequent intervals to establish a true shape of the pressure - buildup curve. If possible, sufficient time should elapse between initial shut-in and final bottom-hole pressure record to give a completely built-up static pressure.

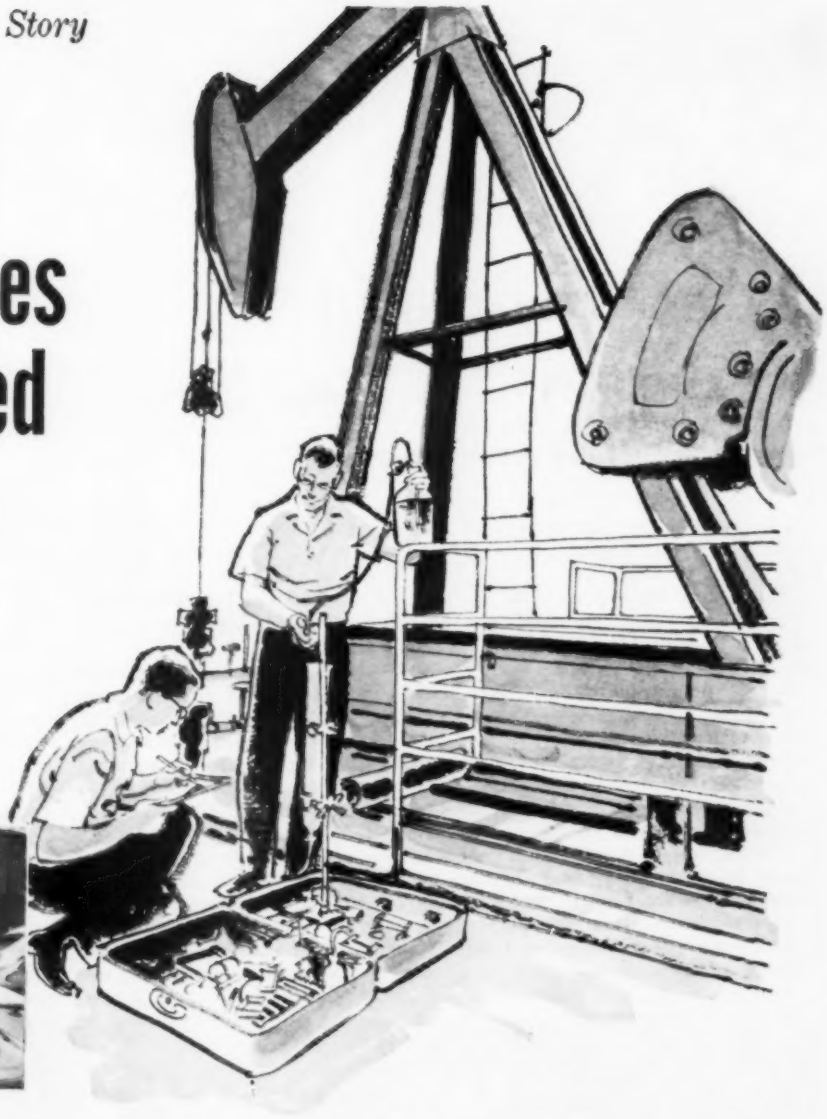
7. When the subsurface gage is removed, pressures are determined from the recording chart.

8. A productivity index is calculated from the observed production rates and the subsurface pressure measurements obtained.

1958 Summer Success Story

A Story Of 20 Suitcases That Opened 500 Times

with an important demonstration for secondary oil recovery operators



The man you see above is one of 20 young chemical engineering students who have, since June, conducted an unusual "flow rate" demonstration for secondary recovery operators throughout the Southwest. It's all been part of *Program 20,* inaugurated by Chas. Pfizer & Co., Inc.

Conclusive Proof of Citric Acid Effectiveness

In more than 4 out of 5 tests, conducted at the well head, citric acid significantly improved water injection flow rates. Program 20 representatives were able to demonstrate graphically citric acid's remarkable ability to sequester iron salts preferentially thus *preventing "iron plugging" of the sandface.*

If water flooding is your business, and you were unable to invite a *Program 20* man for this demonstration, you can still write to the Pfizer Chemical Sales Division in Brooklyn and arrange for a Pfizer representative to visit your well head with the water quality kit.

He will also give you information on the use of citric and gluconic acids with detergents in well clean out procedures, and information on the use of these same acids in HCl acidizing.

Test and Data are Free!

He will leave you a complete and valuable test report plus a Fact File that includes comprehensive technical information and research data for secondary oil recovery. Why not take advantage of this unusual opportunity?

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At Sinclair's Corpus Christi refinery

Hydrofluoric acid alkylation has been smoothed down to an effective, economical process

BY LARRY RESEN
Refining Editor

OPERATION of the hydrofluoric acid alkylation unit at Sinclair Refining Co.'s Corpus Christi, Tex., refinery has been characterized by low isobutane - olefin ratios, low acid consumption, high-quality alkylate product, and high efficiencies.

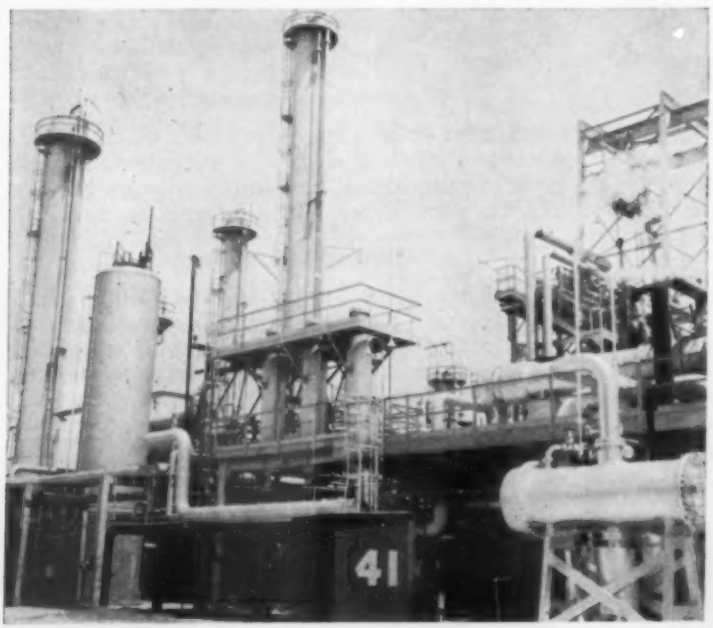
The wartime unit has been operated continuously since its construction and modifications have generally been of a minor nature. A major change was the addition of a second stripping tower. Defluorination is so effective that not only are the secondary bauxite towers bypassed, but only one of the two primary bauxite towers is necessary in the process.

At the present time the unit is receiving an olefin charge in which 31% of the olefin is propylene. Acid consumption under these conditions averages 0.303 lb. per bbl. of light alkylate and isobutane-olefin ratio is less than 5 to 1. The F-4 performance number of the light-alkylate product is 146.8, leaded

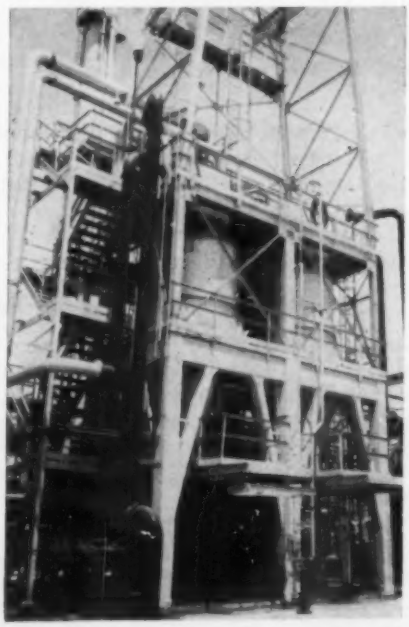
A closed isobutane refrigeration cycle is used for chilling the contactors. The 500-ton unit used enables the contactors to operate at the low temperature of 70° F. The isobutane refrigerant has no relationship to the process streams.

Process . . . The incoming feed stream is commingled with the isobutane recycle stream containing isobutane makeup as required. The combined isobutane - olefin stream is passed through a caustic-wash drum and driers before being charged to the contactors. The Stratco 50 contactors operating in parallel are used for the reaction step, with acid being recycled to them from the acid settler. These contactors are vertical impeller-type installations and are equipped with bayonet tubes used in chilling the contents.

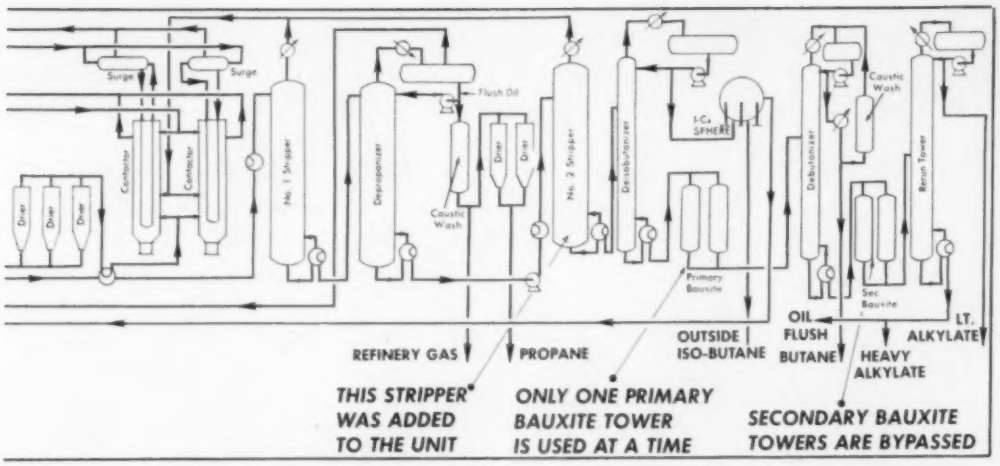
Reactor effluent passes to the acid settler and from here hydrocarbons are withdrawn overhead to the stripper surge drum. Acid from the settler is recycled to the contactors with a slip stream withdrawn for charging to the acid regenerator.



INCOMING isobutane-olefin feed stream is caustic-washed and passed through three parallel driers before entering contactors.



TWO vertical impeller-agitated Stratco 50 contactors operate in parallel.



FLOWSHEET of Sinclair's hydrofluoric acid alkylation unit at Corpus Christi, Tex., shows process which is producing a better product at higher efficiency than in the past.

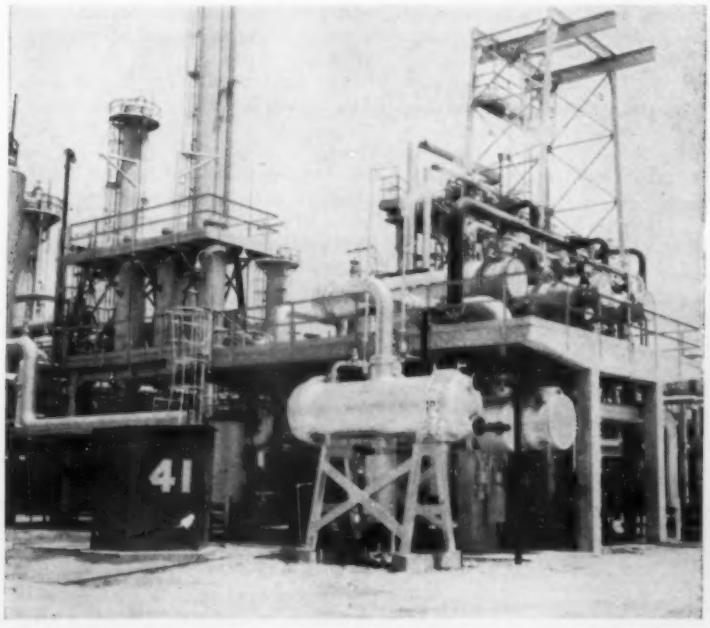
Butylene-propylene charge is processed at low reactor temperatures with low isobutane/olefin ratios and low acid consumption. Alkylate quality is high.

Strippers . . . The two stripper towers are installed so they straddle the depropanizer in the flow scheme. The original stripper is upstream of the depropanizer and the new tower is located downstream of the depropanizer. The hydrocarbon stream from the stripper surge drum is charged to the first stripper from where bottoms are taken off and serve as charge to the depropanizer. The depropanizer bottoms, in turn, serve as charge to the second stripper.

Purpose of the strippers, or azeotropic towers as they're sometimes called, is to defluorinate the hydrocarbon stream. This is accomplished primarily within the towers in a flash operation, with the fluorides passing overhead. The stripping towers are packed with aluminum Raschig rings, with 2 ft. of iron rings on top of the aluminum rings.

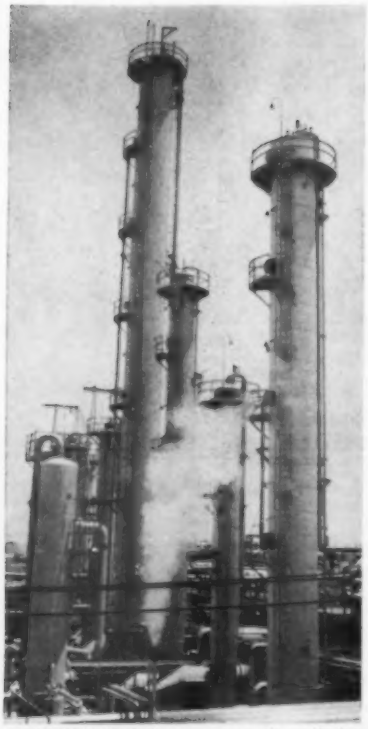
The overhead streams from the two strippers are recycled to the contactors. Depropanizer overhead is condensed and accumulated with a propane product being withdrawn after being caustic washed and dried. Vapors from the accumulator are drawn off and recycled to the acid regenerator.

Fluoride removal . . . The effect of the strippers and depropanizer is to remove much of the fluorides upstream of the bauxite towers. The relatively high weight per cent of fluorides in the feed stream to stripper No. 1 is immediately reduced by 35% in the outgoing stream. A small reduction is achieved in the depropanizer where fluorides are removed overhead. The feed to stripper No. 2 contains 50% of the fluorides in the original hydrocarbon stream. Fluorides are further removed in this second stripper and a small amount remaining passes through the deisobutanizer and passes through the primary bauxite tower, where fluoride content is finally



CLOSED isobutane refrigeration cycle is used to lower contactor temperatures.

PRIMARY bauxite towers are at far left.



FRACTIONATION towers in the alkylation plant.

FINAL DEFLUORINATION of the hydrocarbon stream takes place in a pass through one of the two primary bauxite towers at right. Secondary towers in foreground are bypassed.

reduced to 0.00050 wt. %, from the 0.00196 wt. % charged to the tower.

The small amount of fluorides handled at this point accounts for the low attrition rate of the bauxite contents of the tower. Hence, only one tower is required to handle the entire process stream, and it can operate a minimum of a year without being recharged. Likewise, this low concentration makes it possible to bypass the secondary bauxite towers downstream of the debutanizer.

LABORATORY INSPECTIONS

	Light alky.	Heavy alky.
°API	72.5	55.3
I.b.p.	128	320
10 per cent	177	334
50 per cent	210	354
90 per cent	229	430
End point	275	530
R.v.p.	4.6	.....
Octane:		
MM	92.0	.....
RM	94.3	.....
PN F3	129.5	.....
PN F4	146.8	.....

Fractionation . . . Isobutane overhead from the deisobutanizer goes to storage. Makeup is added at this point. Total isobutane feed, then, is taken from this storage to be commingled with the incoming olefin charge. Isobutane from an outside source is also entered into this tank for makeup. After leaving the primary bauxite tower the deisobutanizer bottoms are charged to the debutanizer where butane product is split out overhead.

Bottoms from the debutanizer pass into the rerun tower where the final product split is made into light alkylate and heavy alkylate (trimer). A slip stream pulled off the heavy alkylate line is used as flushing oil in sealing glands on all pumps in acid service. In many units, isobutane is used for this service. However, should leaks develop, this valuable raw material is lost through evaporation. The heavy trimer, meanwhile, can be recovered in sumps and reprocessed without any significant loss.

The light alkylate product has an API gravity of 72.5° and a research octane number of 94.3, an F-3 performance number of 129.5, and an F-4 performance number of 146.8. Common practice is to blend this back to a 115/145 aviation-grade stock with catalytic naphtha. Final blend will usually include 89% alkylate, 8% cat naphtha, and 3% toluene.

Acid consumption under these conditions runs to 0.303 lb. per bbl. with acid strength held at a minimum of 95%. Volume per cent yield of aviation alkylate based on olefin feed is 142.5

WEIGHT BALANCE

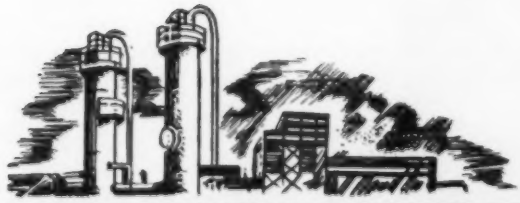
Charge—	Bbl. per day	Volume (%)	Lb.per bbl.	Lb. per day
PP BB	3,118	92.8	197.61	616,156
Iso-makeup	243	7.2	197.20	47,920
Yields:				
Liquid propane	562	16.7	178.07	100,075
Normal butane	463	13.8	205.72	95,308
Alkylate	1,528	45.5	243.10	371,457
Trimer	363	10.8	265.26	96,288
Acid tar	3	0.1	316.60	950
Volume loss plus	+442	13.1	.....	.....
Total	3,361			664,078

Acknowledgment . . . Cooperation of the management of Sinclair Refining Co. in the release of this information is gratefully acknowledged as is the assistance of C. F. Mallory, operating superintendent, and W. E. Bernard, technical department, Corpus Christi refinery.

Smithco pioneered the development of this rugged cooler for severe application. Its functional design, with *excess* cooling capacity, has met and overcome *every challenge* of extreme weather and operating conditions.

The "D" series cooler, latest in the growing tradition of fine Smithco Air Coolers, combines years of qualified engineering experience with the newest manufacturing methods to give you the most dependable unit in it's field.

Their reputation for dependability has attained for Smithco coolers industry wide usage and universal recognition.



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Representatives in the Petroleum Industry

SMITHCO
Engineering Inc.

CAT FUEL INJECTION EQUIPMENT CUTS COSTS BY PROVIDING MAXIMUM ENGINE PERFORMANCE

Presetting at factory for accurate performance eliminates field settings, makes installation of Caterpillar fuel injection pumps quick and simple.

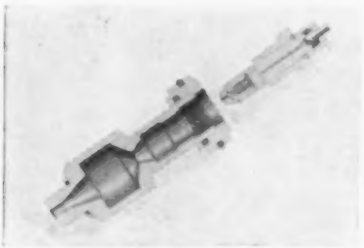
The fuel injection system is a key to peak engine performance. It must deliver to each cylinder equal amounts of fuel at precisely the right time. Deviation means a loss in horsepower. That's why it pays to use Cat fuel injection equipment.

Cat injection equipment can save you money in other ways, too. No field or operating adjustments are necessary. Installation is *quick and simple*. All pumps are interchangeable for different cylinders and between engines of the same model.

This interchangeability permits smaller parts inventories, makes replacement inexpensive by eliminating custom fitting, and makes replacement possible in a matter of *minutes* right on the job regardless of the experience of the mechanic.

Genuine Caterpillar injection equipment is built to last. With clean fuel, a life of 20,000 service meter hours is not unusual.

Pumps, plungers and barrels are manufactured from the finest chromium alloy, so hard that diamond dust is required for lapping the plungers and barrels. Pumps are tested and preset at the factory to provide accurate metering, timing and fuel pressure.



HIGHEST STANDARDS in the industry go into the manufacture of Caterpillar fuel injection equipment. Pump plungers and barrels, for example, are finished to tolerances so fine that the heat from your hand will expand a plunger enough to make it larger than the matching barrel.

SERVICE TIP

Your Caterpillar Dealer has the testing equipment to determine accurately when fuel injection systems parts should be replaced. And testing is the only sure way of knowing.

RUN-IN TESTS—four hours on pumps, two on valves—are conducted on these Caterpillar-built test machines before a pump or valve leaves the factory. Strict testing procedure means perfect performance of genuine Caterpillar injection parts.

Single-orifice fuel injection valves minimize the possibility of clogging or fouling. A spring-loaded plunger within the valve opens by fuel pressure at the proper time for uniform and precise injection. Extra protection is given by a fine-mesh screen. This clean, accurate injection means less down time and lowest fuel cost per unit of power.

Don't risk real damage to your Caterpillar equipment with an improperly functioning fuel injection system. Test systems regularly and replace worn parts with genuine Caterpillar parts. Your Caterpillar Dealer has the full story. See him today. And remember, he stands behind every part he sells.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

Improper fuel injection equipment can be expensive. For instance, if a machine's owning and operating cost is $10 per hour, its total cost in a 2,000-hour season is $20,000. For a 200-horsepower machine that's $100 per horsepower. A poorly functioning fuel injection system which robs the machine of 5% of its horsepower (10 HP) could mean a season loss of $1,000 (10 [HP] x $100). Don't take chances. Standardize on Cat equipment.

CATERPILLAR

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Simple analog computer finds line pack

A NATURAL-GAS pipeline company must take precautions to insure its ability to deliver contracted quantities of gas to its customers.

There are two avenues of approach to this problem. The first is to design the pipeline system to 100% capacity to meet peak-demand loads. The other is storage of gas at various points along the pipeline, either in storage fields or in the pipe itself.

Gas-delivery rates are not constant and vary greatly from one day to the next. In fact, the demands of the customers vary considerably from one hour to the next. For this reason, it is not economically feasible to design a pipeline system capable of flowing a maximum amount of gas that would be equal to the peak demands of the customers.

Most of the gas-transmission companies assure their customers a minimum amount of fuel by using the pipeline itself as a storage volume. Since gas is compressible, it is possible to store relatively large quantities in small containers. With proper methods, pressures can be manipulated to make the pipe volume a usable short-time storage space.

The pipeline itself then serves two functions—one as the carrier for transmission of the gas, and the other as a storage volume.

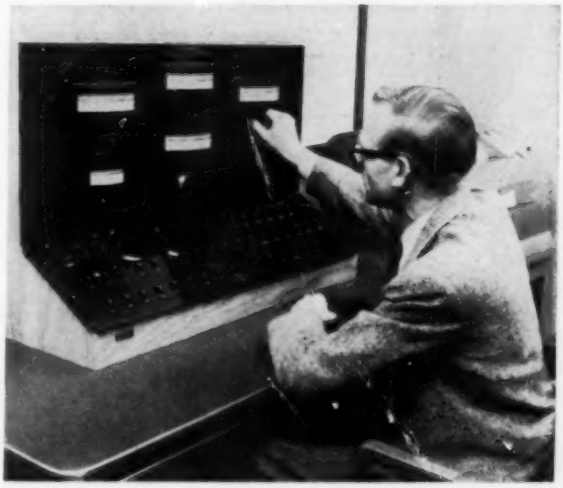
Line Pack and Dispatching

When the gas sales for any one day are unequal to the amount of gas entering the pipeline it becomes necessary to employ the storage function of the pipe itself. This happens regardless of whether the sales are greater than the input or less than the input.

The amount of gas contained in a flowing transmission line is commonly called "line pack." This mass of gas becomes an equalizing factor allowing a pipeline to be operated in a fairly constant fashion. Usable line pack may be defined as that amount of gas which may be withdrawn from the pipe without disturbing the transport function of the line.

A gas-transmission line normally has compressor stations at intervals along its length. Each connecting section of line may be characterized as having its own pack, which is controlled by relative pumping rates of two adjacent compressor stations.

Paper presented at ASME meeting, Denver, September 24, 1958.



AUTHOR H. A. Larberg demonstrates how the Packometer shortens the job of finding line pack.

BY H. A. LARBERG
Panhandle Eastern Pipe Line Co.,
Kansas City, Mo.

The dispatcher can distribute the "draw-down loss in pack" or "pack buildup" along a system by varying the suction and discharge pressures of such compressor stations. It is possible for the dispatcher to be in the process of increasing pack in one section of line and simultaneously operating another section under a pack drawdown condition.

Although in the operation of a pipeline it is necessary to know the correct amount of gas stored in the system, the daily change in pack is of even more importance. A definite level of pack must be maintained for correct operation of a pipeline. When this level is known to the dispatcher he uses it as a target at which to aim during the normal peak demands of the day.

Experience has proved that this peak occurs between 5 a.m. and 7 a.m. of any given day. It is during the peak demand period that there most likely will be a loss in system storage. Thus the dispatcher, by recognizing the change in pack, can better allocate compressor horsepower, keep the suction and discharge pressure of the compressor stations more constant, and keep up to date on an abnormal change in sales.

It is not unusual for a dispatching department to receive the exact sales figures as late as 10 days after such deliveries are made. It is necessary to provide the dispatcher with a prompt approximation of any abrupt change in sales conditions. Such a condition shows up in pressure values, and therefore, can be estimated in magnitude by the change in line pack.

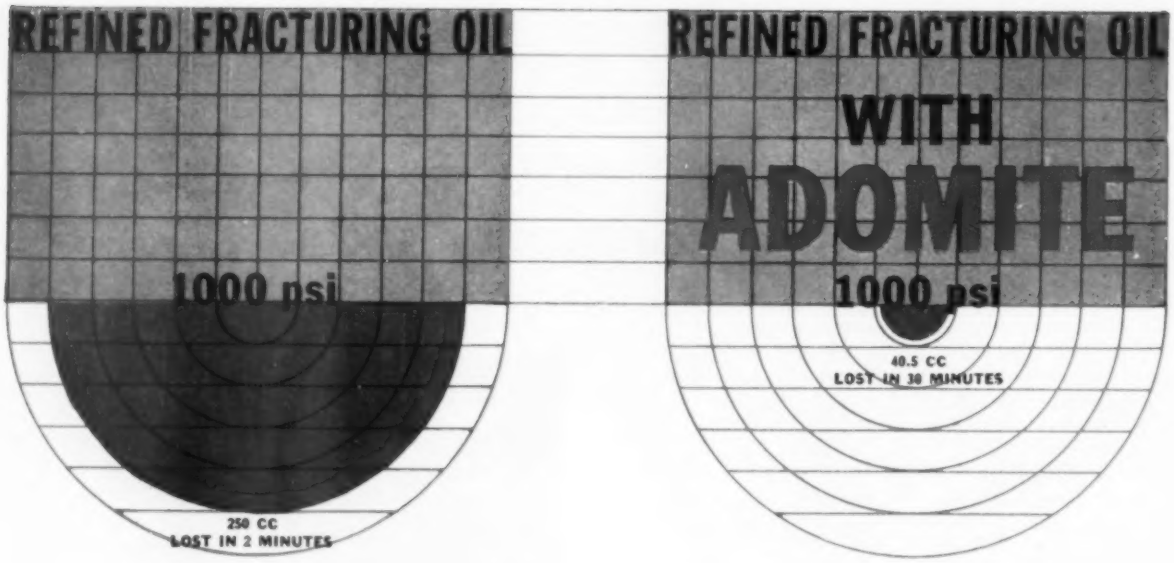
Computing Line Pack

Obviously, the dispatcher must have continuous knowledge of the pack condition in each section of line so he can properly allocate the compressor horsepower for efficient operation. Pack can be calculated for a segment of a pipeline section from the basic gas law.

$$Q = \frac{P_m V}{P_o Z}$$

where:

Q = line pack (cu. ft.)
V = volume of the segment (cu. ft.)
P_m = mean pressures (psia.)
P_o = standard pressure (psia.)
Z = compressibility constant at P_m



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For your next fracture or refracture job, you can be sure of better results by using Adomite to minimize fluid loss. Specify Adomite through your service company.

	Fluid Loss cc/30 Min.	
	100 psi	1000 psi
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Gelled Crude Oil	22.0	Inf.
Gelled Crude Oil + Adomite..	6.0	16.5
Refined Frac. Oil.....	21.0	250/2 min.
Refined Frac. Oil + Adomite..	18.0	40.5

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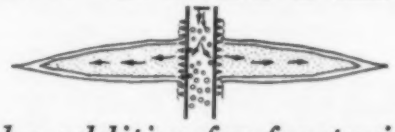

...the additive for fracturing!

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On the Job

PIPELINING

A pipeline section is often comprised of a series of segments, and the dispatcher could obtain the pack of any one section by calculating the pack of its segments and adding the volumes. This would be a tedious and time-consuming chore. It is likely by the time he arrived at the answer, the actual pressure conditions of the section would have changed and he would know little more than when he started.

It has been found that this lengthy arithmetic can be eliminated by correlating segment packs for various pressure conditions to a simple equation that yields the total section pack. The equation is:

$$Q = aP_1 + bP_2 + c$$

where:

Q = pack in cubic feet
P_1 = upstream pressure
P_2 = downstream pressure
a, b, c = constants for a specific section

This equation is known in the gas industry as the "Pack Equation" and can be solved to obtain the quantity stored in the line. The values of a, b, and c of each line section are determined from computed values of pack quantities over a considerable range of pressures.

These values are inserted in the equation and the constants are determined for each set of conditions. The average value of each constant is then used for future calculations. The dispatcher, to use this equation, must have these constants available and must be adept in handling figures. The chance of human error is great and should be eliminated.

Even with the help of mechanical computing machines, considerable time would be needed to obtain the total pack of a system. For example, Panhandle Eastern Pipe Line Co.'s transmission system is comprised of 48 sections of pipeline. Assuming 2 minutes are required to obtain the pack of each section, better than 1½ man-hours would be used each time the total pack was calculated.

Nomographs have been devised for the solution of the pack equation in an attempt to lessen the human error and to speed the operation. They offer a distinct advantage over the direct arithmetic method, but anyone who is familiar with nomographs and their use is aware of their shortcomings such as drifting error in producing the original, error encountered in reproductions and different readings obtained by different personnel.

Packometer Solution

The Packometer is an instrument designed to solve the Pack Equation rapidly and accurately. It is in reality a simple analog computer, the circuitry being an electrical analogy for the equation. The instrument is not only capable of determining the actual line pack but is able to determine the differential of pack when it is changing.

The Packometer shown in Fig. 1 is the first such built and was designed for the Panhandle Eastern system. The face is composed of three voltmeters, two ammeters and numerous switches. One of the voltmeters is labeled line voltage and serves as a visual check of the supply voltage. The other two voltmeters are labeled P_1 and P_2 and are calibrated in psi.

The two ammeters are calibrated in M.M.c.f. and are located one above the other in the center of the face, one labeled "Q" and the other "ΔQ." The supply voltage is obtained from a regulated direct-voltage source. The Packometer itself is approximately 30 in. high, 36 in. wide, and 16 in. deep.

Each section of natural-gas pipeline handled by the Packometer has its specific constants wired in the circuit. The operator can choose any section of the system by manipulation of the proper switch. The upstream and downstream pressures are simulated on two voltmeters and the pack is indicated on the proper ammeter and is labeled "Q."

The Panhandle Packometer has incorporated in its design the 48 sections of line that comprise the Pandle system. It is normally located in the dispatching office and the dispatchers determine the pack by selecting the proper switches and adjusting pressures for each section.

Many times it is necessary to know the pack in two or three sections rather than the total pack in the system. Of course, each of the sections in question must be determined and a total is obtained by manual additions. Other models than the one shown are capable of totalizing the pack. We have determined that a Packometer capable of totalizing does not warrant the additional cost.

One feature of the Packometer that is very useful is its ability to determine the change in pack. A change in either the upstream pressure or downstream pressure or both from an original condition will alter the original pack. The operator determines the section pack in the described manner and then transfers this value to the ΔQ meter by proper positioning of the Q—ΔQ switch.

The Q meter is then zeroed by manipulation of the appropriate dial.

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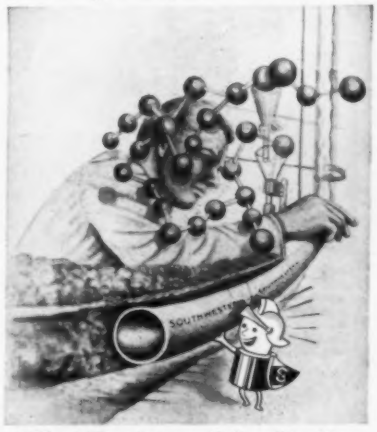

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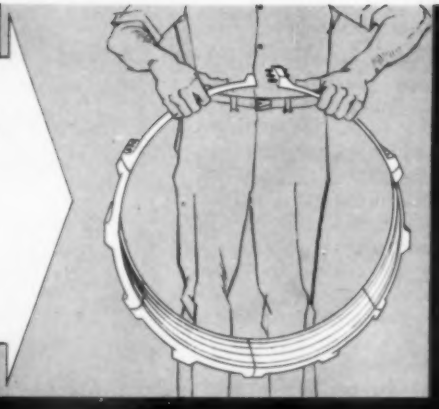
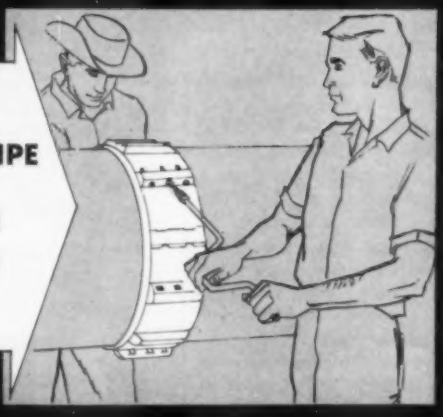
SWP-1

SHIPPED IN ONE PIECE



SNAP AROUND PIPE

TIGHTEN 3 LARGE BOLTS



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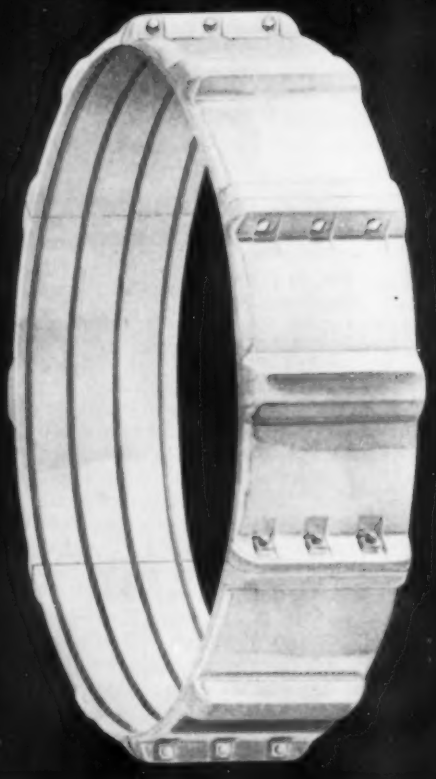
IT'S A 'SNAP' FOR BIG-INCH PIPELINES



TOUGH AS A BOOT . . . HERE'S PROOF!

SNAPS BACK TO ORIGINAL POSITION

When the meter is zeroed, the operator then alters the pressure levels to the secondary values and reads the change in pack registered on the Q meter. If the pack increases, the meter indicates the amount of increase reading to the right; if the meter reads to the left, the pack has decreased by the amount so indicated.

This feature also allows the dispatcher to know by what amounts the pressures can be altered and still hold the pack constant. Such information is obtained by adjusting the terminal pressures, P_1 and P_2, the necessary amount to maintain a zero reading on the ΔQ meter.

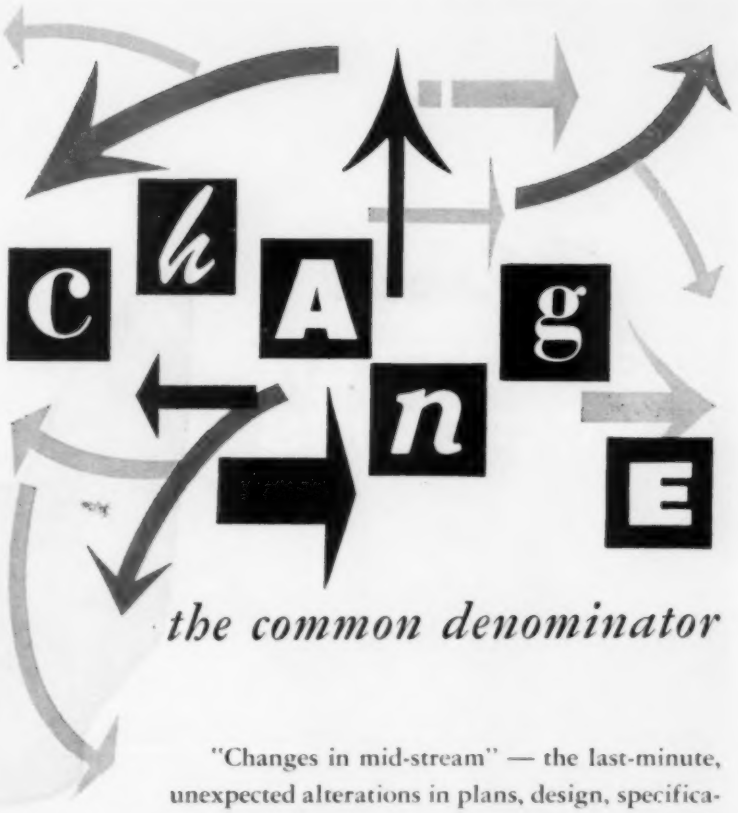
Normally, at Panhandle, pack is figured every 4 hours around the clock, and if as little as 20 minutes is saved each time, by use of the Packometer, a total of 2 man-hours a day is then realized for use on other projects.

We have not attempted recently to measure the time difference in actual operation of the Packometer compared to other methods but several individuals were timed when the unit was first installed. They averaged 10 to 15 minutes determining the total pack, whereas 30 minutes was the average time required by the old method using nomographs.

Rapid, accurate dispatching is the key to efficient operation of a pipeline system, especially during periods of great pressure fluctuations. The very rapid determinations made possible by the Packometer can result in increased sales capacity during sudden cold periods as the extreme maximum of usable pack can be always utilized.

The Packometer, as stated before, is a simple analog computer and as such, is a tool which makes work easier and saves time. The Packometer affords the dispatcher a simple and rapid method of determining the amount of gas stored in a pipeline. It eliminates the need of time-consuming mathematics, and the need of keeping a family of nomographs.

A patent for this instrument is pending. Because of this patent application, the circuitry has not been presented. Also, the method of determining the values for the various circuit elements cannot be shown. The instrument operates on direct current at whatever voltage level might be desired. The circuit elements are linear in nature and it is believed that this is the first time such elements have been used in an approach to the line-pack problem.



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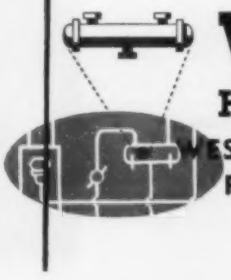
There's nothing *new* about change in the chemical, petrochemical and refining industries — and adjusting to these changes as they relate to heat transfer requirements has become a specialty at Western.



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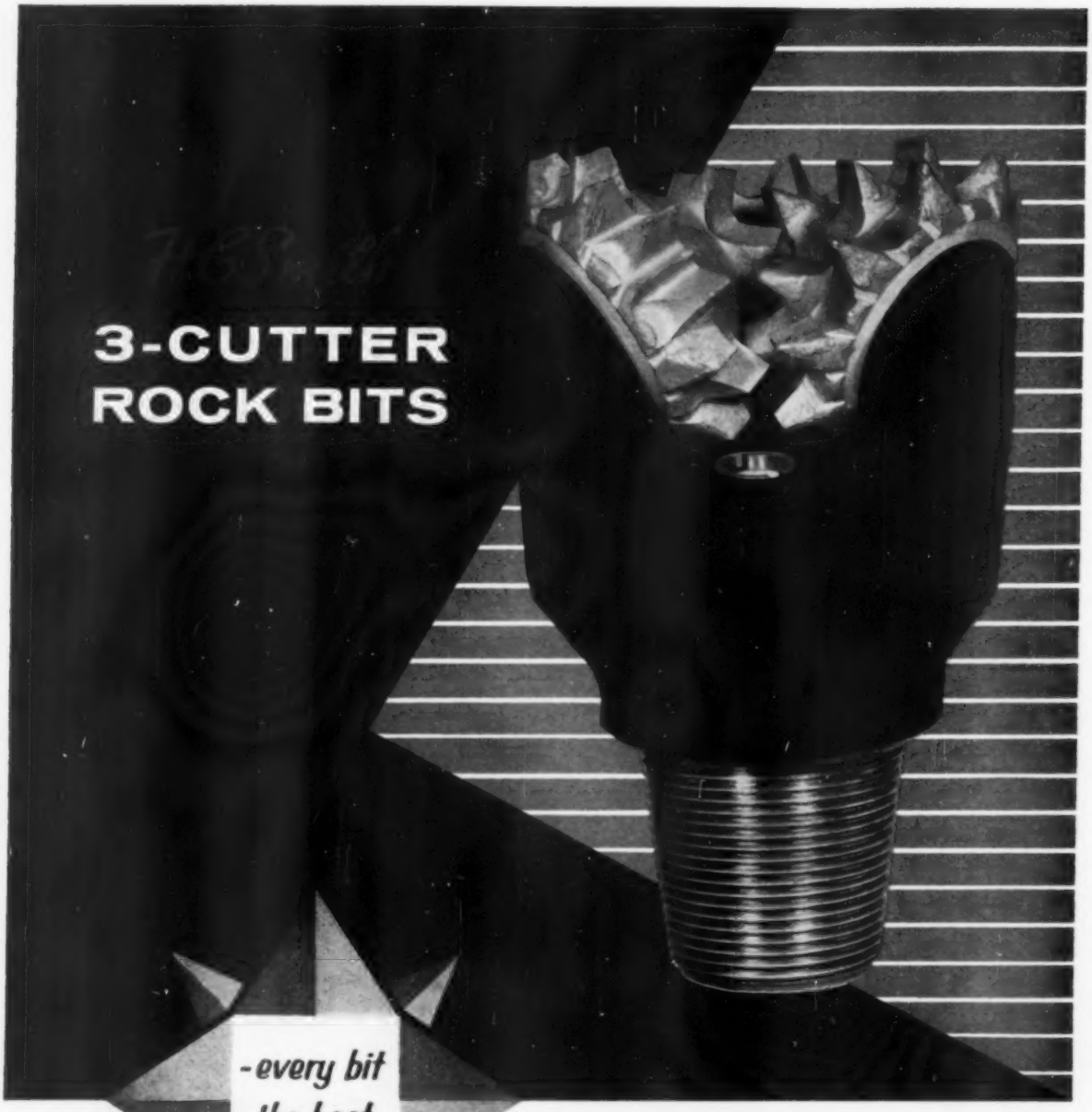

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Calgary-based contractor drilling six-well Queen Charlotte project

DRILLING IS MOVING ALONG on the six-well exploratory program Cascade Drilling Co., Ltd., of Calgary, Alta., is carrying out on contract for Richfield Oil Corp. on Canada's Queen Charlotte Islands, off the Pacific Coast of British Columbia.

Cascade now is on its second wildcat of the six it contracted to drill. Hole is below 4,000 ft. with Richfield planning to take the test through the indicated sedimentary basin.

The first wildcat was abandoned recently after finding more volcanic section than expected. It did not get down to its projected depth.

Five of the tests are on Permits acquired under farmout agreement by Richfield from Consolidated Mic Mac Oils, Ltd., and Canadian Homestead Oils, Ltd. The sixth will be on a tract which Richfield obtained directly and owns outright.

Queen Charlotte Islands belong to British Columbia. They are separated from the mainland by Hecate Strait. There are five main islands, Graham, Moresby, Lyell, Louise, and Kunghit. This area covers 3,970 sq. miles. All of the islands are mountainous except Graham where the drilling is taking place.

Sediments on Graham Island are Jurassic and Triassic in age. The most promising sector for oil prospects on the island lies on the east coast. This area is all taken up for drilling. The Department of Mines of British Columbia has granted 58 permits covering rights to 2,736,065 acres.

The 1 Masset is the first wildcat drilled on this island. This Richfield et al. wildcat lies on Unit 77 of Zone 1, National Topo Map No. 103 F-16. It went to 1,840 ft. into volcanic section. This well was on Permit 822.

The second well, currently drilling, is the 1 Tow Hill. It lies on Unit 33, Zone C of NTS Map 103+ J-4, on Permit 824.

Tentative locations were announced last week for the other four wildcats on the island. They are 1 Gold Creek, Unit 56, Zone H, NTS Map 103 F-9, Permit 849; 1 Tlell Unit 66 of Zone D, NTS Map 103 G-12, Permit 851; 1 Nadu River, Unit 67 of Zone A, NTS Map 103 F-16, Permit 830; and, 1 Lawn Point, Unit 24, Zone L, NTS Map 103 G-5, Permit 880.

New work for contractors picks up in Denver basin

DRILLING IS LOOKING up in the Denver basin of northeastern Colorado and western Nebraska.

New work reported last week and due to get under way at once involves more than a dozen wildcats. Their drilling will keep several contract rigs busy for some time.

Among the new wildcat projects is a four-well exploratory program by Raymond Oil Co. in northwestern Logan County, Colorado, which will be drilled by Murfin Drilling Co., Denver contracting firm.

A series of three wildcat tests will be drilled by Sam Gary in Scottsbluff County, Nebraska, with Roy Shoat, of Denver, as contractor.

McDaniel Drilling Co., also of Denver, already is under way on the first of four wildcats it has contracted to drill for S. D. Johnson, Wichita Falls, Tex., operator, in Morrill County, Nebraska.

Additional new development is scheduled for the indicated new field in eastern Arapahoe County, Colorado, where Tom Vessels, Jr., and Strain Drilling Co., also of Denver, are testing their discovery well. Strain already is starting their second well, 2 Alles, a 40-acre location southeast of the discovery well (1 Alles).

Pan American Petroleum Co. has announced locations for two new Nebraska wildcats, one in Kimball County, and the other in Banner County, but contracts have not been awarded.

Tom Palmer, of Denver, is getting started on another new wildcat south of Lane field, in Kimball County, Nebraska, where he is using his own rig.

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Who's getting the drilling contracts

J. E. Hillier, Pleasanton, Tex., on a 5,000-ft. wildcat test Gail A. Barry, of San Antonio, is starting 4 miles north of Terrell Point field, in southeastern Goliad County, near the Victoria County line, in the central coastal area of Texas.

Nichols Drilling Co., Duncan, Okla., is starting an 8,000-ft. Tulip Creek test on the southwest side of East Noble field, in Cleveland County, Oklahoma. Drilling is for Trice Production Co. with location at 1-A State, in 36-8n-2w.

L & F Drilling Co., Bakersfield, has a new contract operation in the old Trico shallow gas area in northwestern Kern County, California. It is a 7,000-ft. deeper-pay exploratory test for Trico Oil & Gas Co. Location is on the eastern flank of the field at 8 Tulare Farms, in 26-24-23.

Vasser & Brown, Inc., Natchez, Miss., is drilling on a new Tuscaloosa wildcat for Munoco Co., of El Dorado, Ark., in the Bayou Mound area, 4 miles northwest of Winnsboro, in Franklin Parish, North Louisiana. The test, 1 Virgie, in 18-14n-7e, is Munoco's third in this area. The first two were dry. Contract is for 5,000 ft.

Chiles Drilling Co., Alice, Tex., is drilling for Katz Oil Co., of San Antonio, on a wildcat location in the Taft area, San Patricio County, South Texas. It is a 6,000-ft. test at 1 Rothrock.

Thirteen Drilling Co. is contractor on a projected 16,000-ft. test being started in the White Lake area, southwestern Vermilion Parish, Louisiana Gulf Coast. Operator is David S. Thayer, of Houston, whose location is on a state lease, in White Lake.

Longhorn Drilling Corp., Three Rivers, Tex., has another deep-drilling wildcat job coming up for Gulf Resources, Inc., in Southwest Texas' Zapata County. Its new location is at 1 Benavides, in Tract 2, Porcion 22, about 10 miles northeast of Lopena, in the south corner of the county. Permit calls for a 10,250-ft. test. Longhorn now is finishing up on Gulf Resources wildcat 18 miles northeast of Lopena. The latter, 1 Security, in the Delaney Subdivision, Villa Grant, was drilled to 11,186 ft., and is being completed as a gas-condensate discovery well at 9,436-66 ft.

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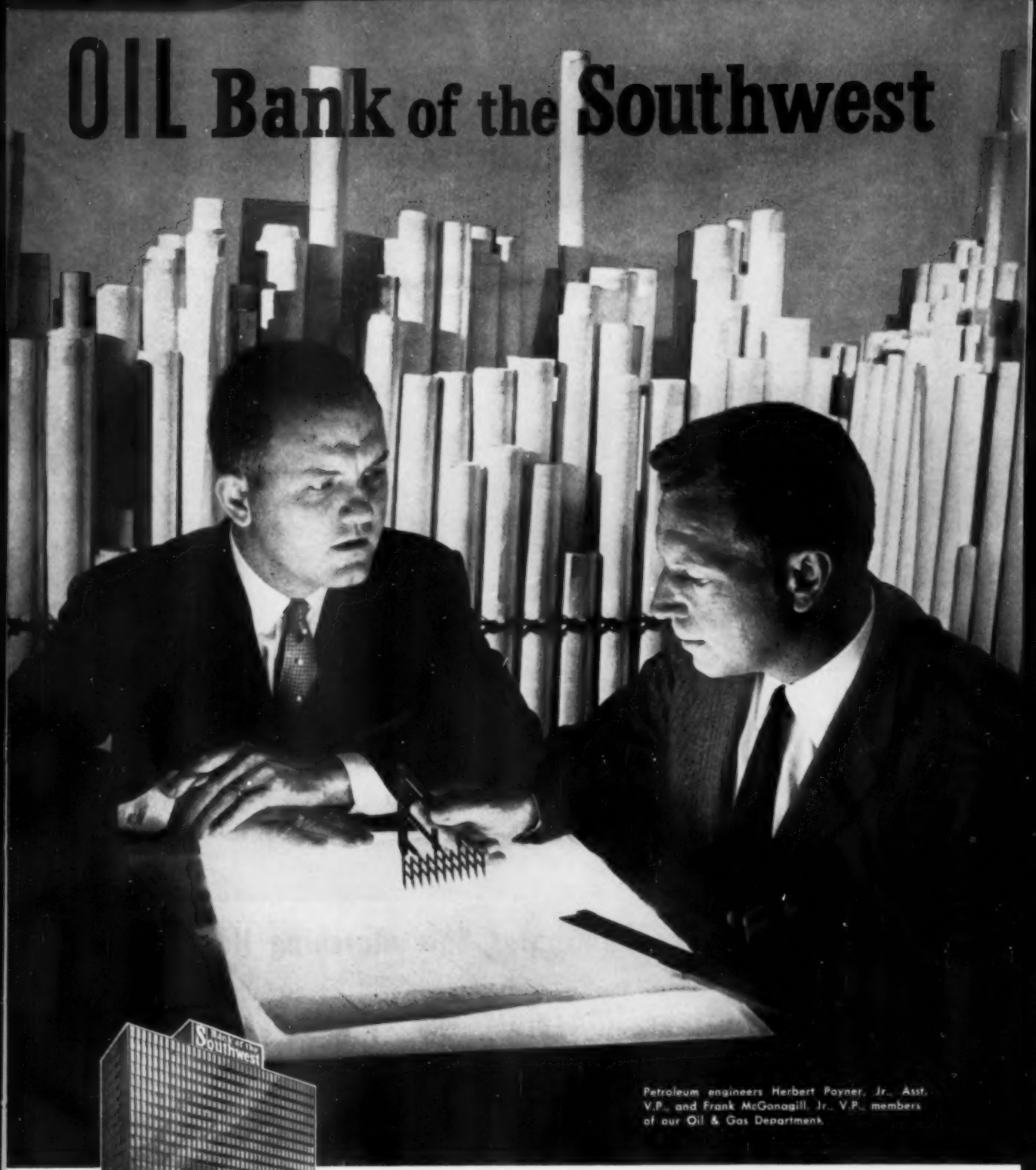

Petroleum engineers Herbert Poyner, Jr., Asst. V.P., and Frank McGonagill, Jr., V.P., members of our Oil & Gas Department.

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BANK OF THE SOUTHWEST offers the ultimate in scope and quality of financing to the petroleum industry. The seasoned members of our Oil & Gas Department were oil men before they were bankers. A large number of our directors and Advisory Committee also are oil men. That's why our bank is known as the Oil Bank of the Southwest. For information, write Harold Vance, vice president and manager, Oil & Gas Department.

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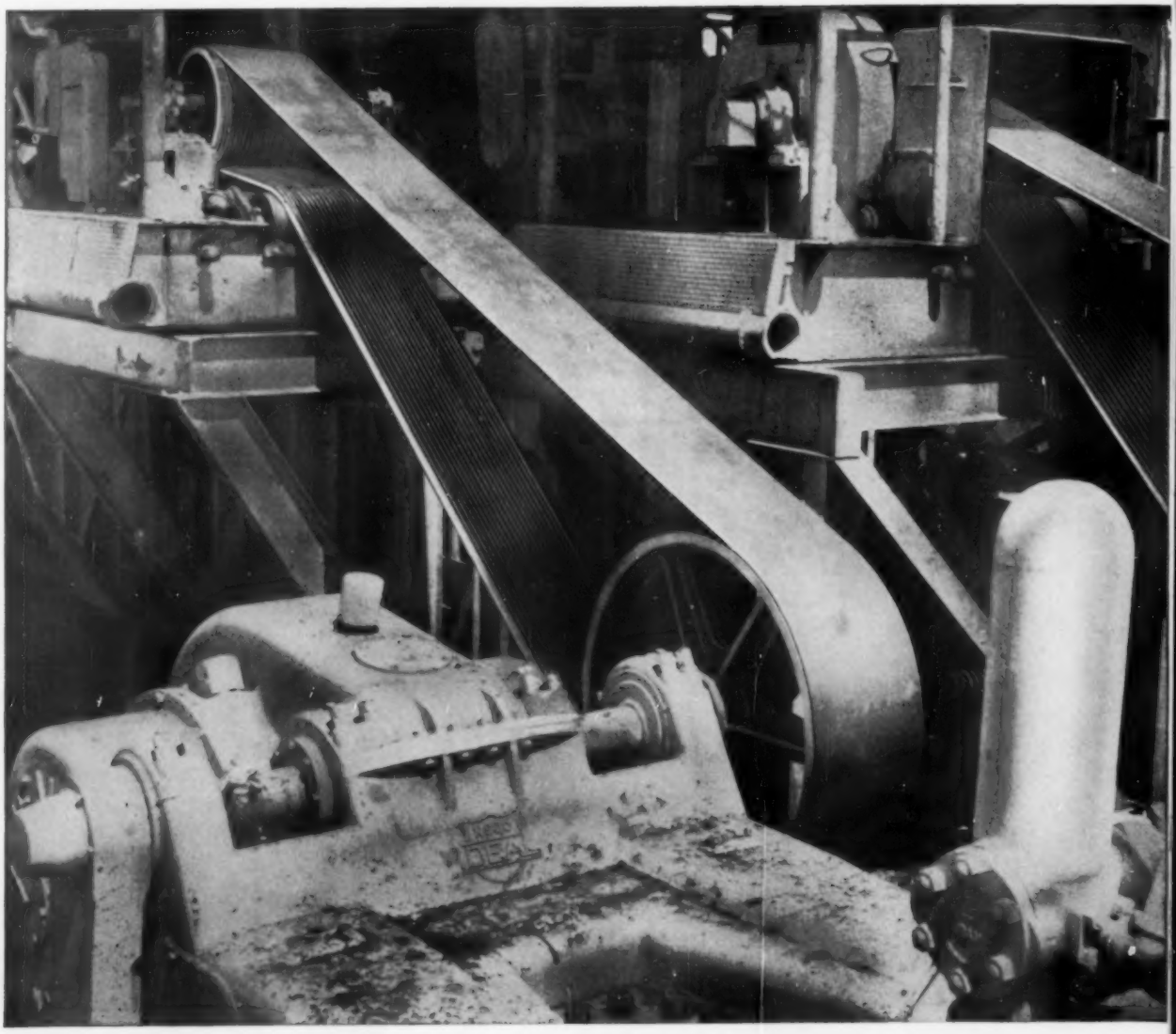

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Unique advantages of R/M Poly-V Drive for *Pumping* and *Drilling*

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No other drive can insure such trouble-free dependability on oil pumper or put as much push in deep hole drilling as R/M Poly-V . . . It delivers up to 50% more power capacity than a conventional V-drive of equal width . . . or equal power in as little as ⅔ the width! Single unit V-ribbed belt permits *narrower sheaves . . . less shaft overhang . . . less drive weight.* Features add up to *extra* push behind a slush pump for today's deeper drilling operations . . . more rapid circulation of mud, faster drilling speeds, longer drill bit life.

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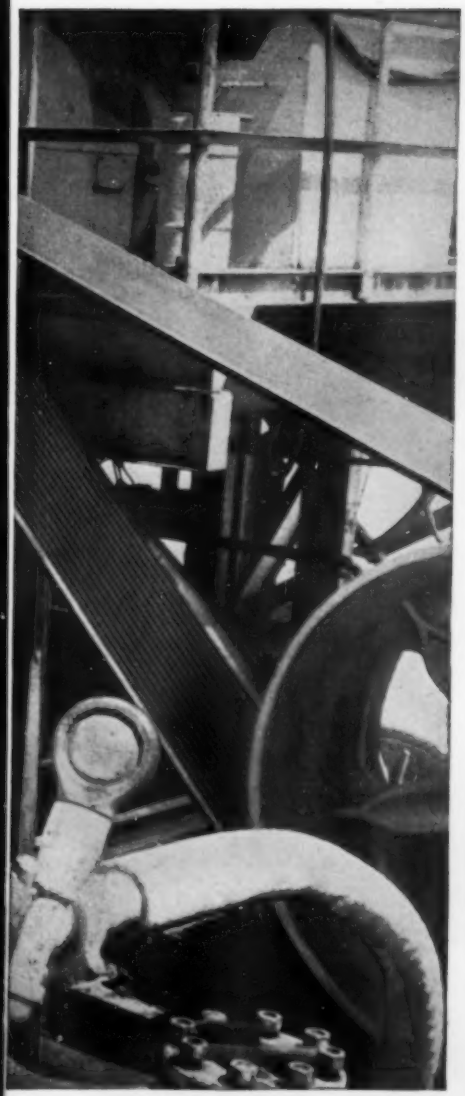

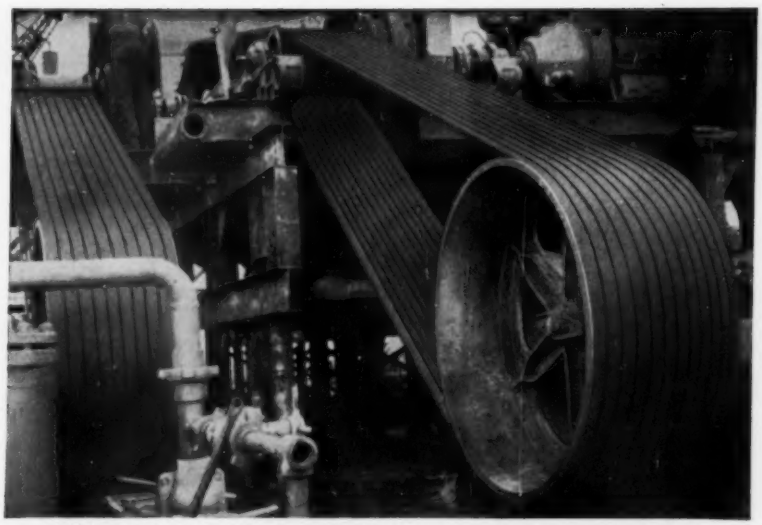

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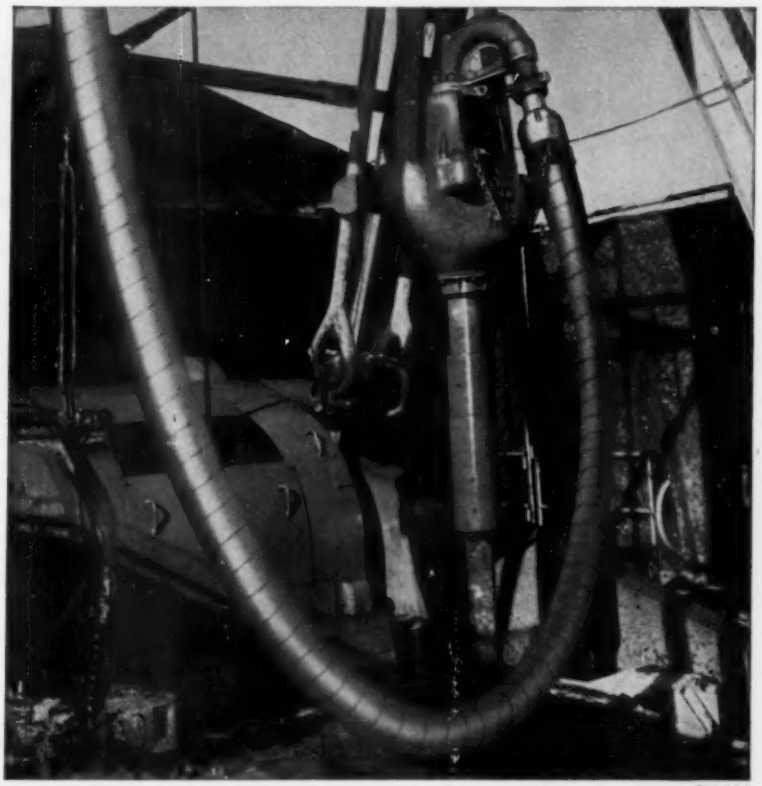

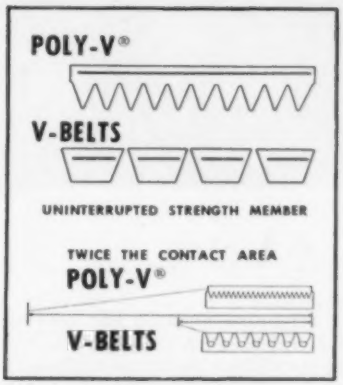

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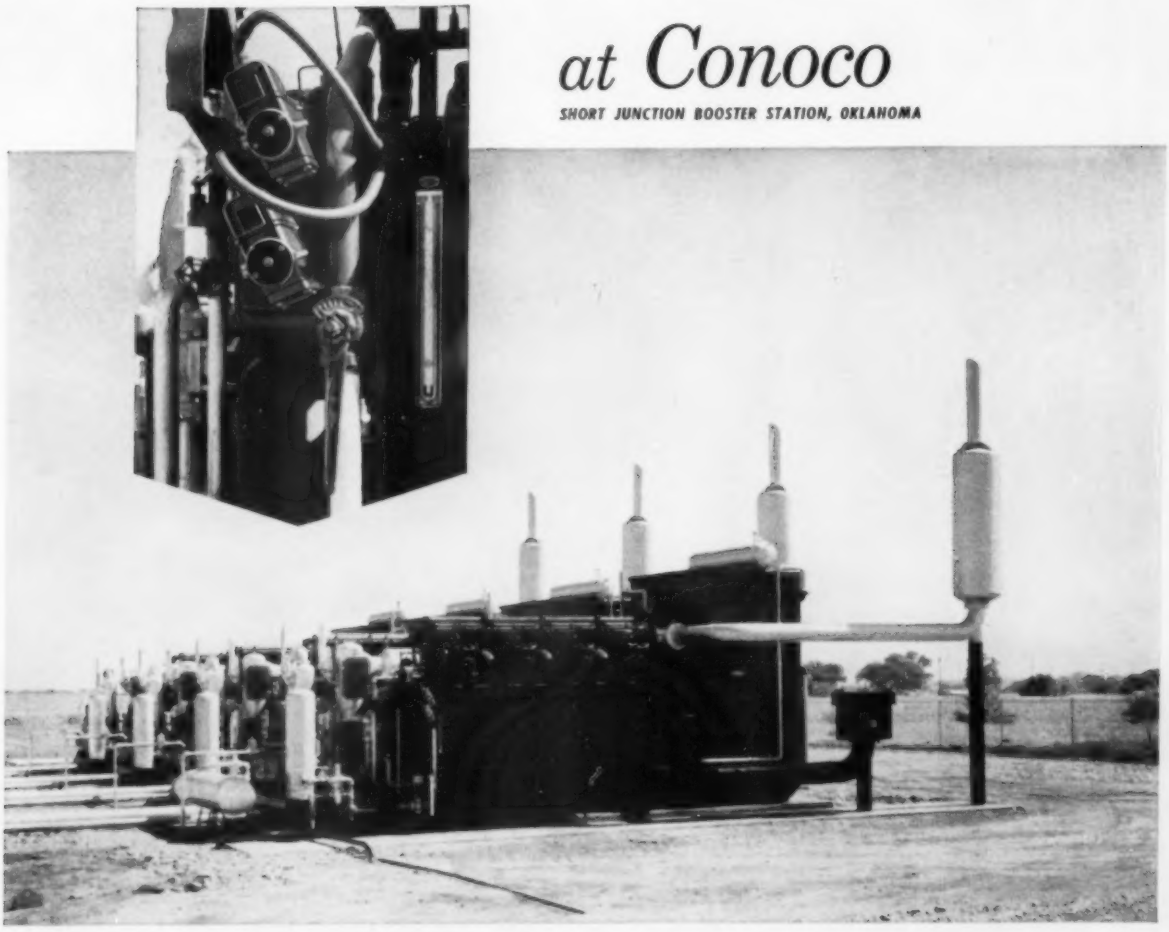

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SHORT JUNCTION BOOSTER STATION, OKLAHOMA

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For many years Bendix ignition equipment has given dependable service in a wide variety of petroleum and natural gas applications. The Cooper-Bessemer gas engines, equipped with Bendix* LAR magnetos shown here, provide efficient, economical gas combustion to help move natural gas through the pipeline system at the Short Junction Booster station of Continental Oil Company in Oklahoma.

Bendix LAR magnetos provide reliable ignition at the lowest operating cost. Reserve power insures smooth running engines, even under the most adverse operating conditions. The Bendix LAR magneto and its companion Hi-V transformer coil are a matched ignition system that meets the most rugged engine requirements.

LA magnetos now in service can be easily converted to the modern Bendix LAR type with conversion kits now available. They can be obtained from your Bendix ignition distributor or from our factory. For complete details, write SCINTILLA DIVISION OF BENDIX AVIATION CORPORATION, Sidney, New York.

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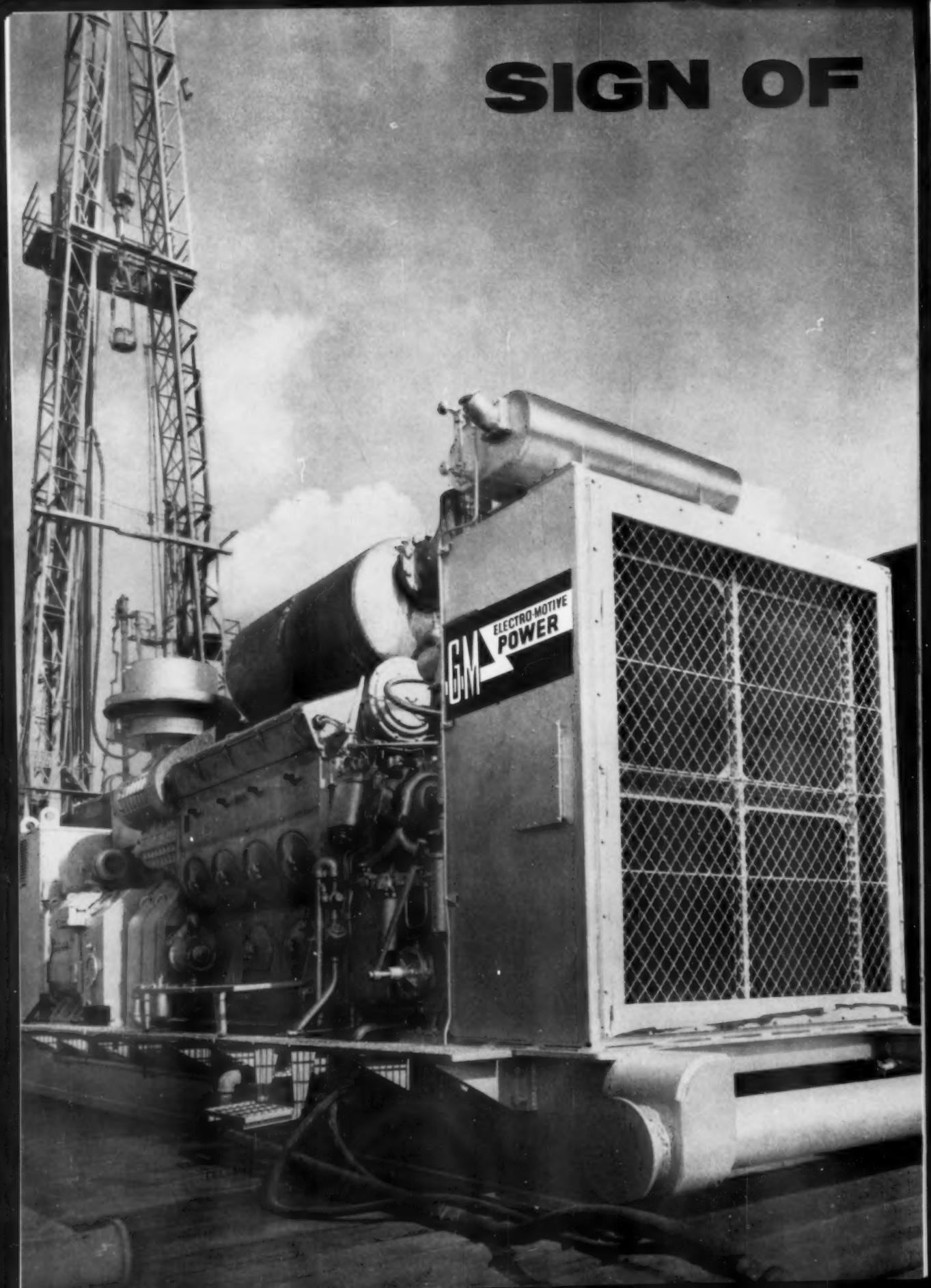
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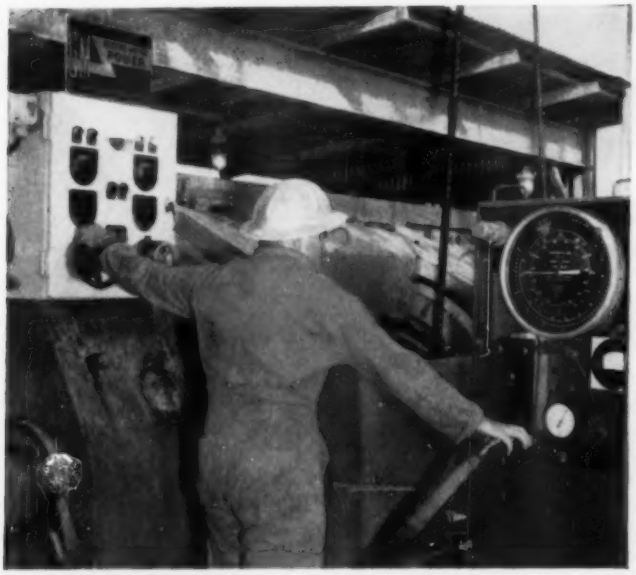

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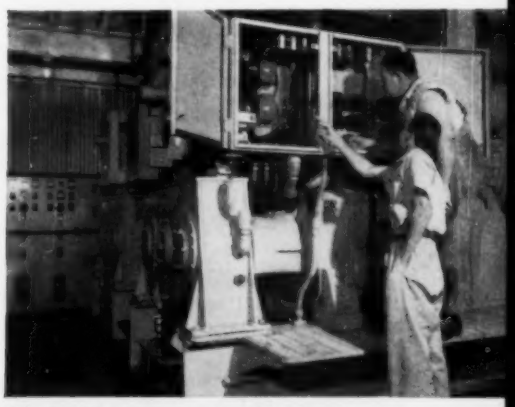

Sign of one manufacturing responsibility. From rig planning through operation. One responsibility simplifies engineering, installation. It means one source for service, parts. It's yours with Electro-Motive Power.

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Only the specially-designed Hancock bonnet joint with built-in compression limit can make full use of the positive sealing power of this ring of steel. Such advanced valve engineering is one example of total Hancock quality that assures trouble-free performance. Your nearby industrial supply distributor will gladly explain every economy feature of Hancock Steel Gate Valves. Phone him today.

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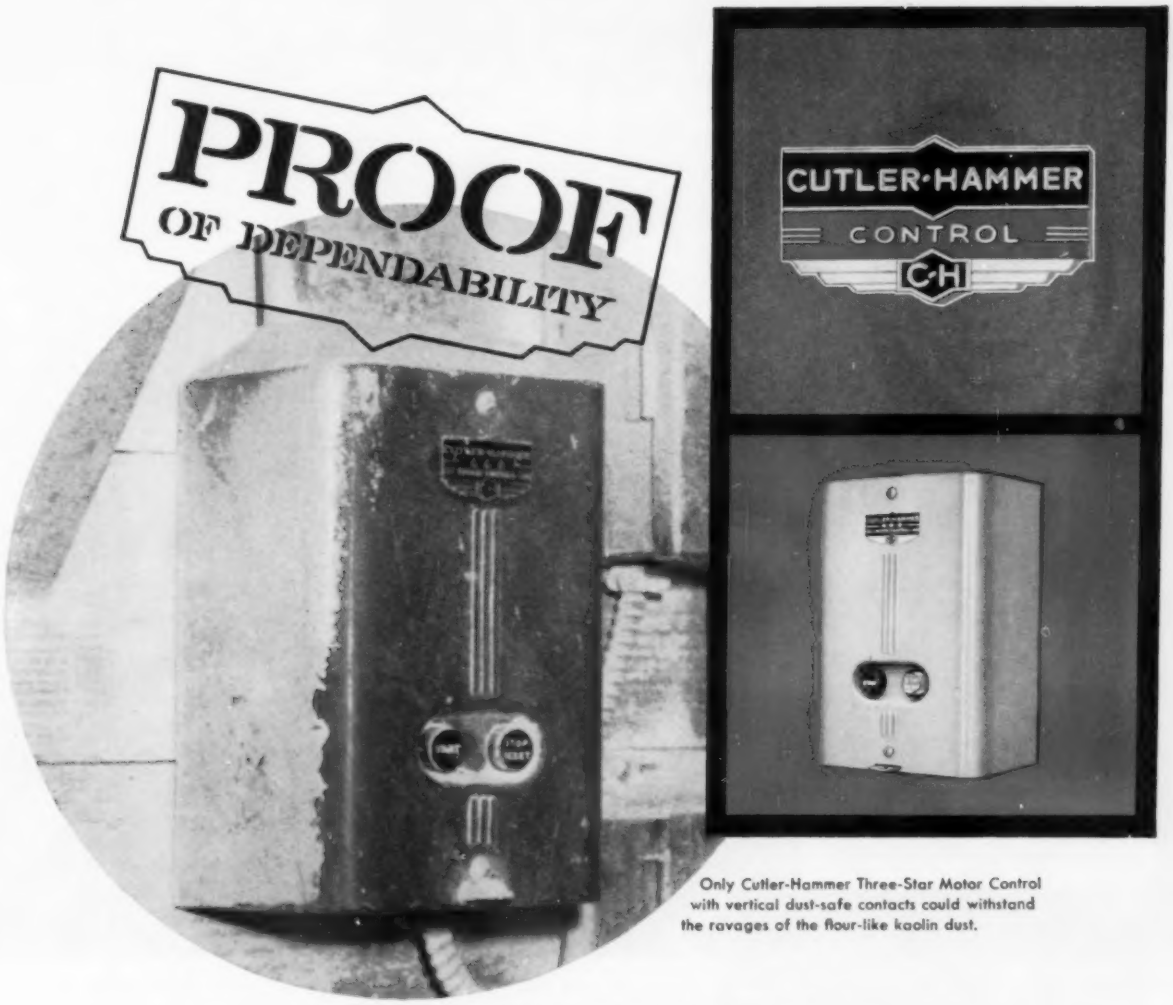

Only Cutler-Hammer Three-Star Motor Control with vertical dust-safe contacts could withstand the ravages of the flour-like kaolin dust.

Large Southern kaolin processing plant cuts maintenance costs with Cutler-Hammer Control

By the very nature of the product, kaolin processing is an extremely dusty operation. Because of this the electrician at a large Southern kaolin plant found it necessary to replace the dust-fouled contacts in the motor starters every 30 to 60 days. Several makes of motor control were tried, but the results were always the same . . . dust laden contacts wore rapidly requiring frequent attention.

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This is positive proof of dependability . . . proof that Cutler-Hammer Three-Star Motor Control works better, lasts longer than any other on the market today. Why take chances with costly production interruptions? Order dependable Cutler-Hammer Three-Star Motor Control from your nearby Authorized Cutler-Hammer Distributor today. For complete ordering information, write for the Cutler-Hammer Merchandiser, EA-100-U27, CUTLER-HAMMER Inc., Milwaukee 1, Wisconsin.

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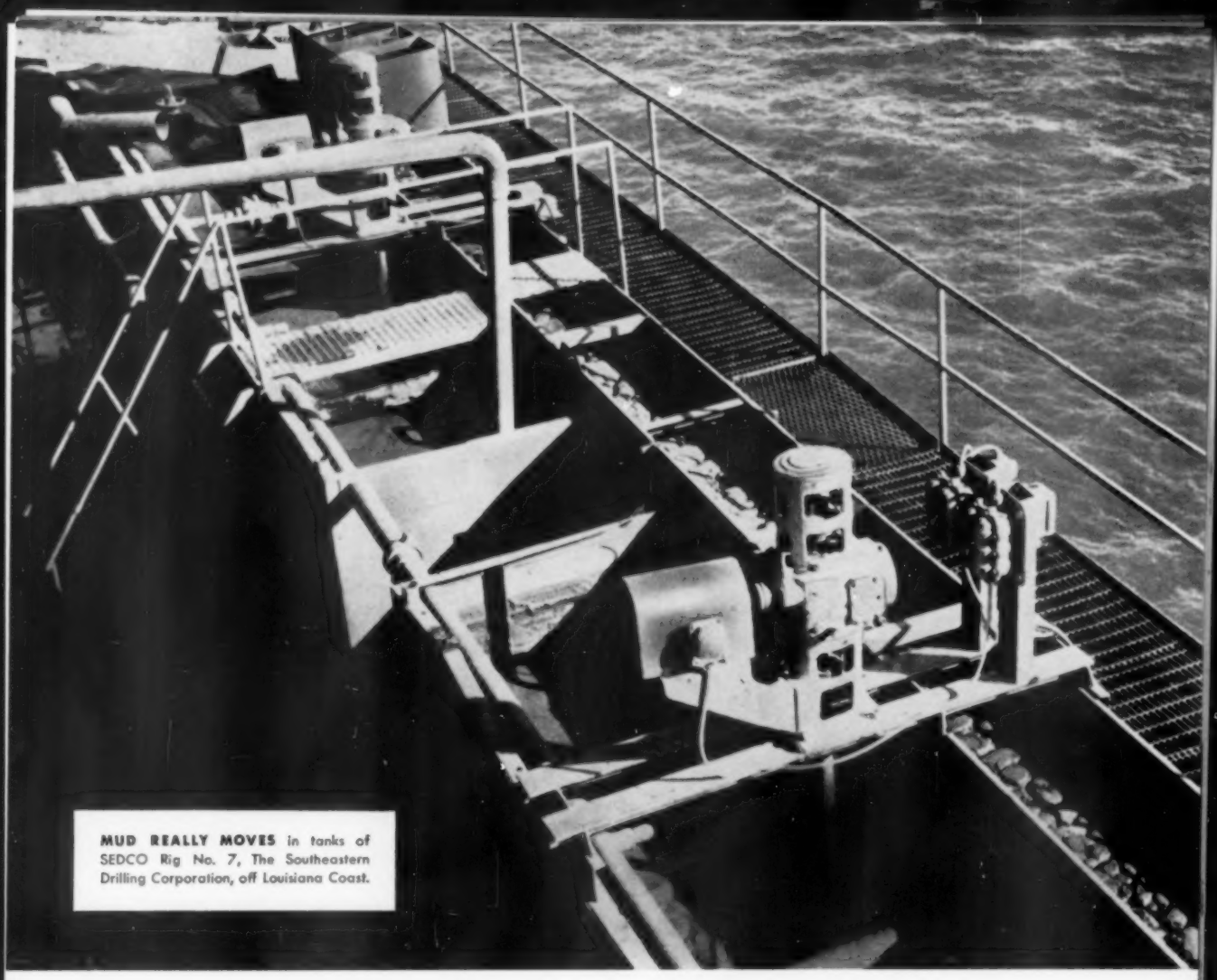


MUD REALLY MOVES in tanks of SEDCO Rig No. 7, The Southeastern Drilling Corporation, off Louisiana Coast.

Want to **do something** *about drilling costs?*

Mud control is one place where you can.

As costs go higher and holes go deeper, your ability to get mud in top condition fast—and keep it there—jumps into focus as the way to save plenty.

You get this kind of control when you equip your mud tanks with LIGHTNIN Mixers. Here's how this simple change in your rig equipment *now* pays back far more than its low cost:

1. Make hole faster—Fewer stops, no long waiting for mud to get into condition. Mud stays ready for instant use—every gallon at the right weight and viscosity.

2. Drill more safely—When you run into hazardous conditions, you can heavy up the mud amazingly fast—*in seconds*—to help protect men and equipment. Dump in weight and gel additions *as fast as you want to.* They're dispersed immediately in the fast-flowing mud.

3. Use less mud—The mud bill is substantially lower with LIGHTNINS because there's no mud wasted in the tank. Mud moves in constant, powerful flow—can't settle out.

4. Invest less capital—You need only one standby mud pump—not two—when you mix with LIGHTNINS. No auxiliary pump is needed for jetting.

5. Spend less on maintenance—much less than with other equipment. LIGHTNINS run for years with very little attention. A simple shaft and impeller are the only parts in contact with mud.

Do it now!

As a first step to more productive drilling, see for yourself what LIGHTNIN Mixers are doing on rigs near you. Your LIGHTNIN representative will gladly arrange a field trip if you call him now. He's listed in Composite Catalog. Or write us direct.

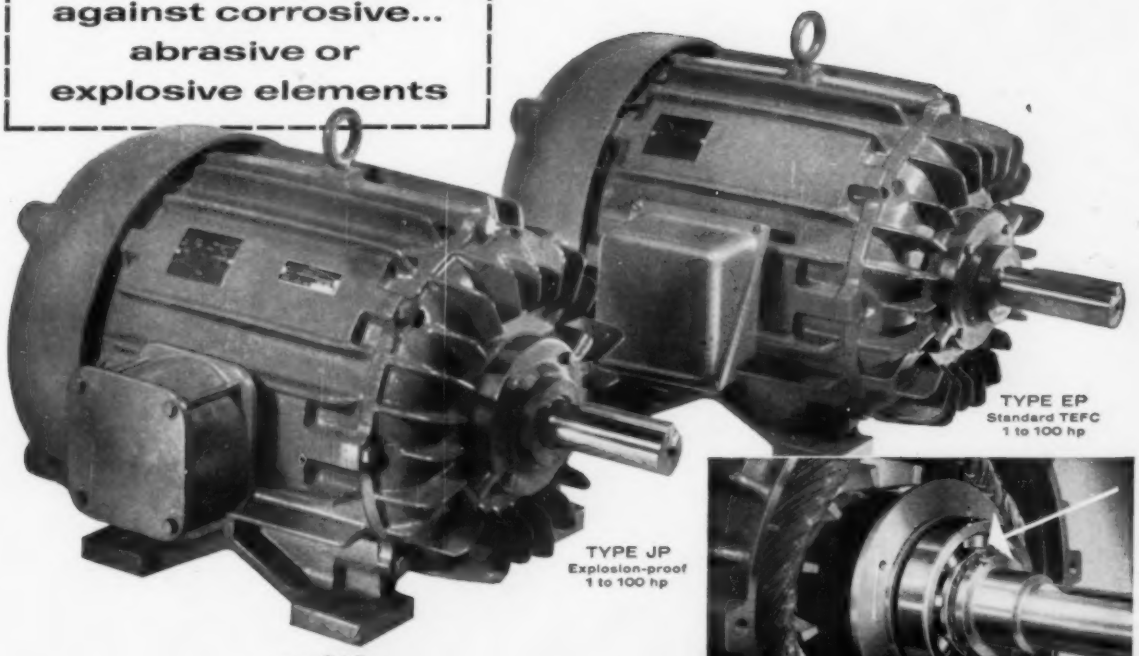
FREE BULLETIN shows how you get instant mud control—at less than your present cost—with LIGHTNIN Mixers. Just drop us a postal asking for Bulletin B-517.

Lightnin® Mixers MIXCO fluid mixing specialists

MIXING EQUIPMENT Co., Inc., 174-k Mt. Read Blvd., Rochester 3, N. Y.

In Canada: Greey Mixing Equipment, Ltd., 100 Miranda Ave., Toronto 19, Ont.

YOU GET
EXTRA PROTECTION
against corrosive...
abrasive or
explosive elements



TYPE EP
Standard TEFC
1 to 100 hp

TYPE JP
Explosion-proof
1 to 100 hp

with Wagner totally enclosed motors...protected for longer motor life

If you need motors that will keep production rates up . . . that will give the continuity of service that is so important to automation . . . that will operate with complete dependability under the most severe conditions—Wagner totally-enclosed motors are your soundest choice.

Type EP Motors offer protection against corrosion, dust, abrasives, fumes, steel chips or filings. Type JP is explosion proof as well—designed and approved for use in explosive atmospheres.

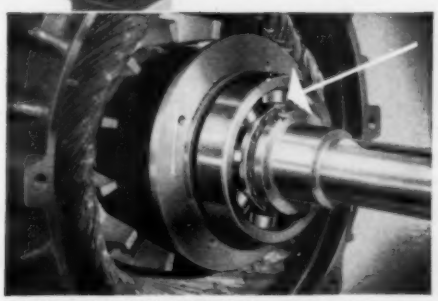
NEW NEMA FRAMES . . . These motors are built in the new NEMA Frame sizes from 182 through 445U, with ribs that add mechanical strength and increase the surface cooling area. Effective cooling system adds to motor life. Let your Wagner Sales Engineer show you how these protected motors can bring you savings on initial motor costs, maintenance costs and continuity of operation.

1 TO 100 HP—4 POLE, 60 CYCLE—
NEMA FRAMES 182 THROUGH 445U

Wagner Electric Corporation
6389 Plymouth Ave., St. Louis 14, Missouri.

WH58-5

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES



HEAVY DUTY BALL BEARINGS . . . The ball bearings used in these motors are of the highest quality, with more than ample capacity to provide long troublefree service under heavy loads.

BEARINGS CAN BE RELUBRICATED . . . Factory installation will last for many years under normal service, but openings are provided to permit relubrication that adds years to motor life under severe conditions.

SEALS KEEP BEARINGS CLEAN . . . Both ends of these motors have running shaft seals to keep the bearings clean. Bearing housings are effectively sealed to prevent escape of grease.

How deep for oil?

How far down into the earth's depths can we go after this vital substance? Today, the question remains unanswered. We are still going down!

However, continuous probing beneath the earth's surface depends on how much punishment tubular materials can stand. They must be worked hard and deep. They must resist twisting action, fatigue and collapse. And they must be ready to meet the more rigid stresses of deeper drilling tomorrow. You can bet when new records are set USS National Seamless Oil Country Tubular Products will be on the job. They are acknowledged the world over as the most ideal materials for deep well work because their strength and dependability can be attributed to two vital factors—quality steel and a unique way of manufacture. Each seamless tube is pierced from a solid billet of steel. And only steel of the very best forging properties and of the highest uniformity can be used, since the modern piercing operation tends to search out any defects in the metal.

For drill pipe, casing and tubing that can really "take it"—products that will consistently give you the most service per dollar invested—remember to specify USS National Seamless Oil Country Tubular Products . . . every time!

USS, National and ◈ are registered trademarks

Some of National Tube's most notable contributions to the oil industry:

National Deoxidized Bessemer Steel Casing and Tubing—Grades H-40, J-55. Especially well suited for oil production because of its combination of high yield strength and good ductility.

National Warm-Worked Casing—Grade N-80. An extremely high-strength casing possessing a uniformity of physical properties which gives it high collapse resistance and greatly increased joint strength. It is hydrostatically tested to 80% minimum yield strength up to a maximum of 10,000 psi.

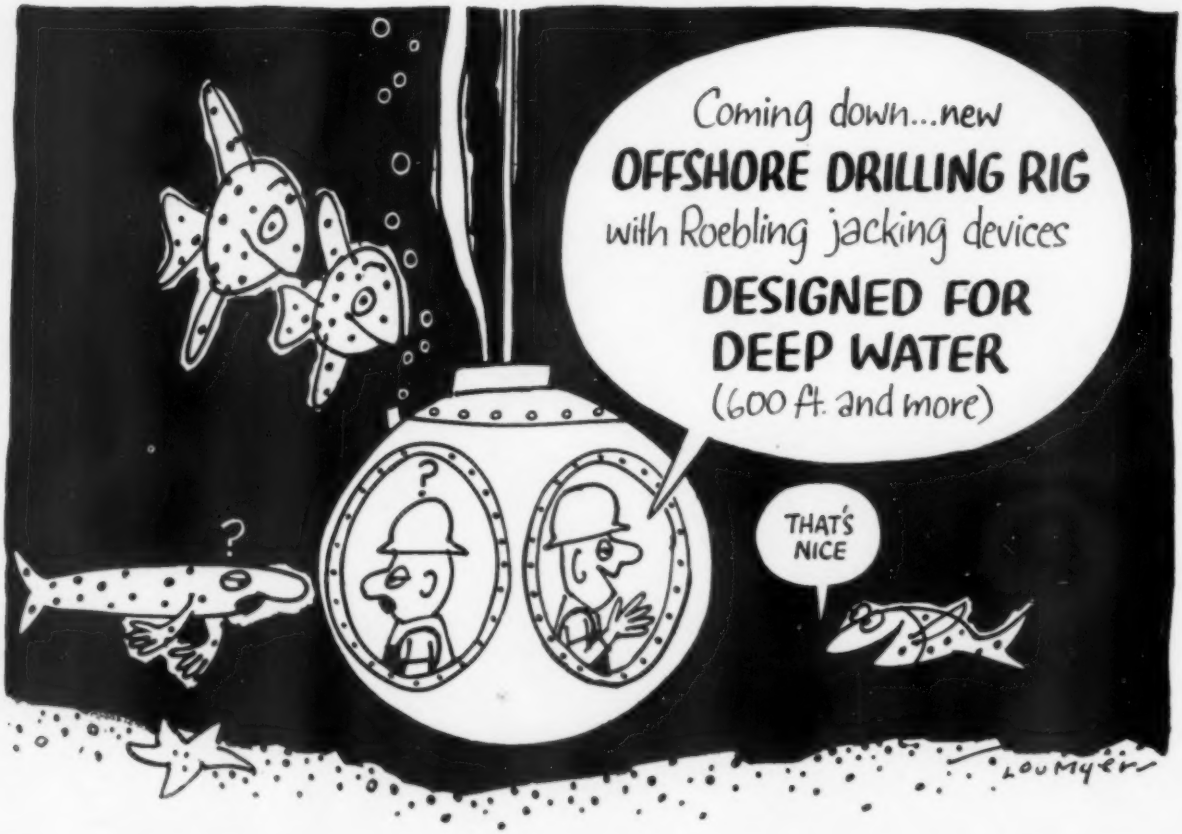
National Deep-Well Casing—The strongest casing produced under API specifications to meet constantly increasing depths. Due to the severe service for which it is intended, it is hydrostatically tested to 80% minimum yield strength up to a maximum of 10,000 psi.

National (B) Buttress Thread—Developed to satisfy the need for a casing joint which will safely and economically support the weight of deep-well casing. The buttress-thread joint is comparable in strength to that of the body of the pipe.

For further information, write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa. Export Distributors: United States Steel Export Company, New York.

"The world's largest and most experienced manufacturer of tubular products . . ."

National Tube Division of United States Steel



Expressly designed for deepwater locations, this equipment enables drilling where present types cannot operate.

The rig (Figure A) is towed to the drilling site in a buoyant condition, with both the anchor and deck float dewatered. At the drilling site, the anchor is gradually filled with water and lowered to the bottom by the jacking equipment. Once at the ocean floor, the anchor is completely filled with water, firmly seating it on the bottom.

While this operation is in progress, the buoyant float (Figure A) remains on the surface. Once the anchor is seated on the bottom, the Roebling jacking equipment goes into operation to bring the deck float down to operating position, which is at a predetermined level below the area wave action (Figure B).

When the drilling rig is to be moved to another area, the jack action is reversed. Strand is released to raise the deck float to the surface. The anchor float is pumped out sufficiently to permit the jacks to raise it to traveling position, under the deck float. During all of these raising and lowering operations, the strand is spooled up and payed off by means of power operated storage reels.

This is another example of how Roebling suspension systems and their principles can be—and are constantly—applied in the unlikeliest of places. Roebling's design, construction and service abilities range far and wide, embracing pipe line bridges, material and personnel tramways, ski lifts, guyed towers, suspended roofs and *suspension systems of all kinds*. We welcome inquiries of any nature on this new equipment for offshore drilling rigs. Write Bridge Division, John A. Roebling's Sons Corporation, Trenton 2, N. J.

ROEBLING

Branch Offices in Principal Cities
Subsidiary of The Colorado Fuel and Iron Corporation

FIG. A

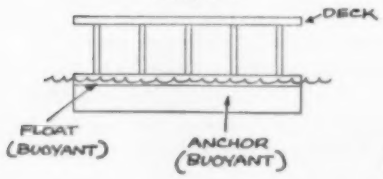
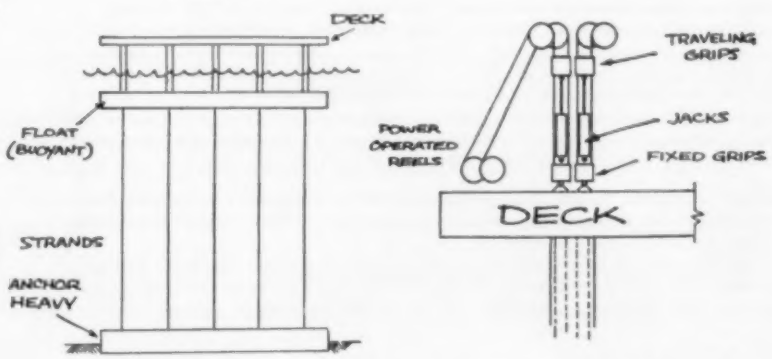


FIG. B



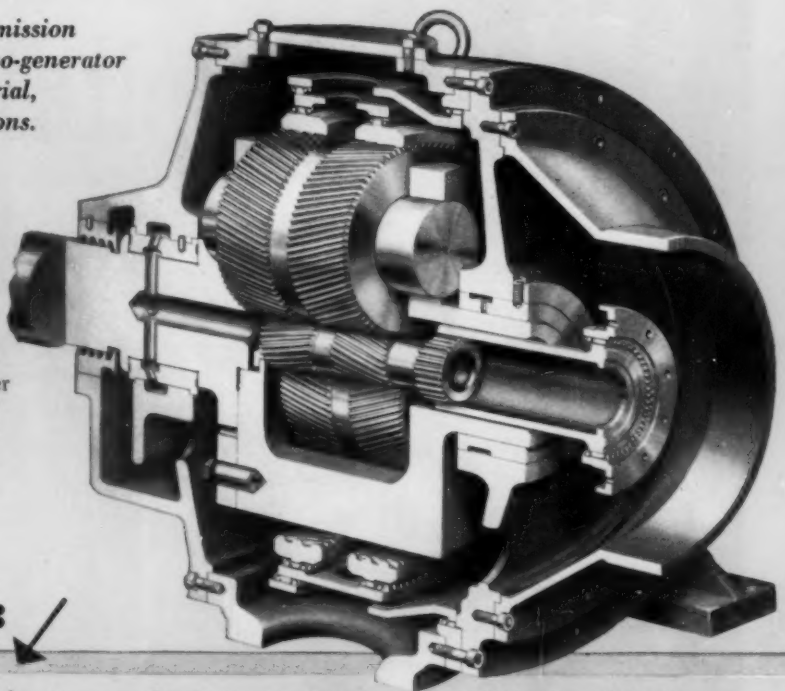
DE LAVAL-STOECKICHT
PLANETARY GEAR

...for high speeds...high horsepower

Proved in hundreds of installations abroad totalling over 3,000,000 horsepower—now available in America!

For all high torque power transmission applications such as pump turbo-generator and compressor drives in industrial, municipal and marine installations.

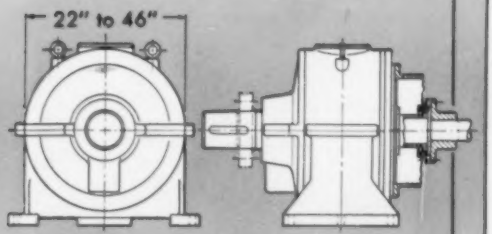
This cutaway view of the De Laval-Stoeckicht Planetary Gear shows how it provides flexibility for proper load distribution throughout the gear members. The thoroughly proved and tested design is completely reliable in transmitting high horsepower for high speed applications. • Highest efficiencies (98% or higher)...no high speed bearings...less friction losses.



Check These Advantages:

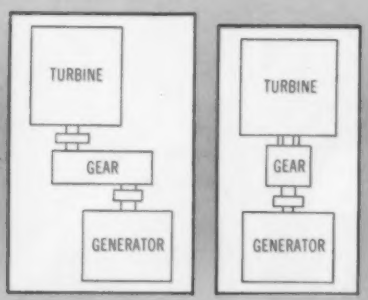
Small Size—Light Weight

Compact—low weight per hp. Sizes range from 22" to 46" in diameter, depending on horsepower requirements. Example: 5000 hp planetary unit weighs 1700 lbs. against 6000 lbs. for conventional gear.



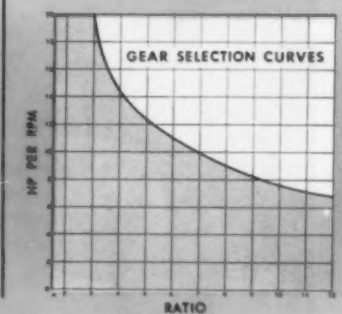
Convenient Arrangement

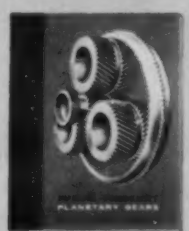
Co-axial or "in-line" arrangement of gear members takes up far less space than parallel axis gears of equivalent horsepower rating.



Wide Application

Capacity range shown in shaded area on chart below. For other applications, contact your De Laval Sales Engineer.





For further details, write for Bulletin 2400.

DE LAVAL *Steam Turbine Company*

810 Nottingham Way, Trenton 2, New Jersey

Driller saves $1700 per well with

The Finest Products
Made with Aluminum
are made with
REYNOLDS ALUMINUM

...longer service lines, installed faster

with Aluminum Oil Country Pipe

. . . That's more than $50,000 per year on 30 jobs, by reaching out farther for low cost gas . . .

The lightweight strength and flexibility of Reynolds Aluminum Oil Country Pipe is really saving money for one Houston drilling contractor—$1700 per well, or more than $50,000 per year!

Oil Production Maintenance, Inc., operating seven power rigs, uses Reynolds Aluminum Pipe for rig service, for both water and gas. Because the lightweight, corrosion-resistant aluminum pipe can be installed so quickly, and so economically, Oil Production can reach out farther, for low cost gas. The fuel savings resulting amount to $50,000 a year on an average of 30 jobs per year.

One of the Reynolds Aluminum Pipe service lines used by this driller is *9½ miles long.* That's more than twice as long as the longest economically-feasible steel pipe line used by this company.

INSTALLATION SAVINGS

Oil Production Maintenance reports that two men can lay a mile of the lightweight aluminum pipe in just two hours. Two men can pick up a mile of aluminum pipe in one hour. This is about ten times faster than laying the same size steel pipe.

The chief reason for this speed is, of course, the light weight of aluminum pipe. But it is also a fact that aluminum pipe is easy to couple, and flexible, so that it follows ground contours readily.

STRONG, CORROSION-RESISTANT

Oil Production operates its tough, seamless Reynolds Aluminum Pipe lines in rough country, under corrosive conditions. Aluminum will not rust—ever, and resists corrosion from water, sour gas, soils, hydrogen sulphite, carbon dioxide, nitrogen solutions, and many other corrosives.

AVAILABILITY

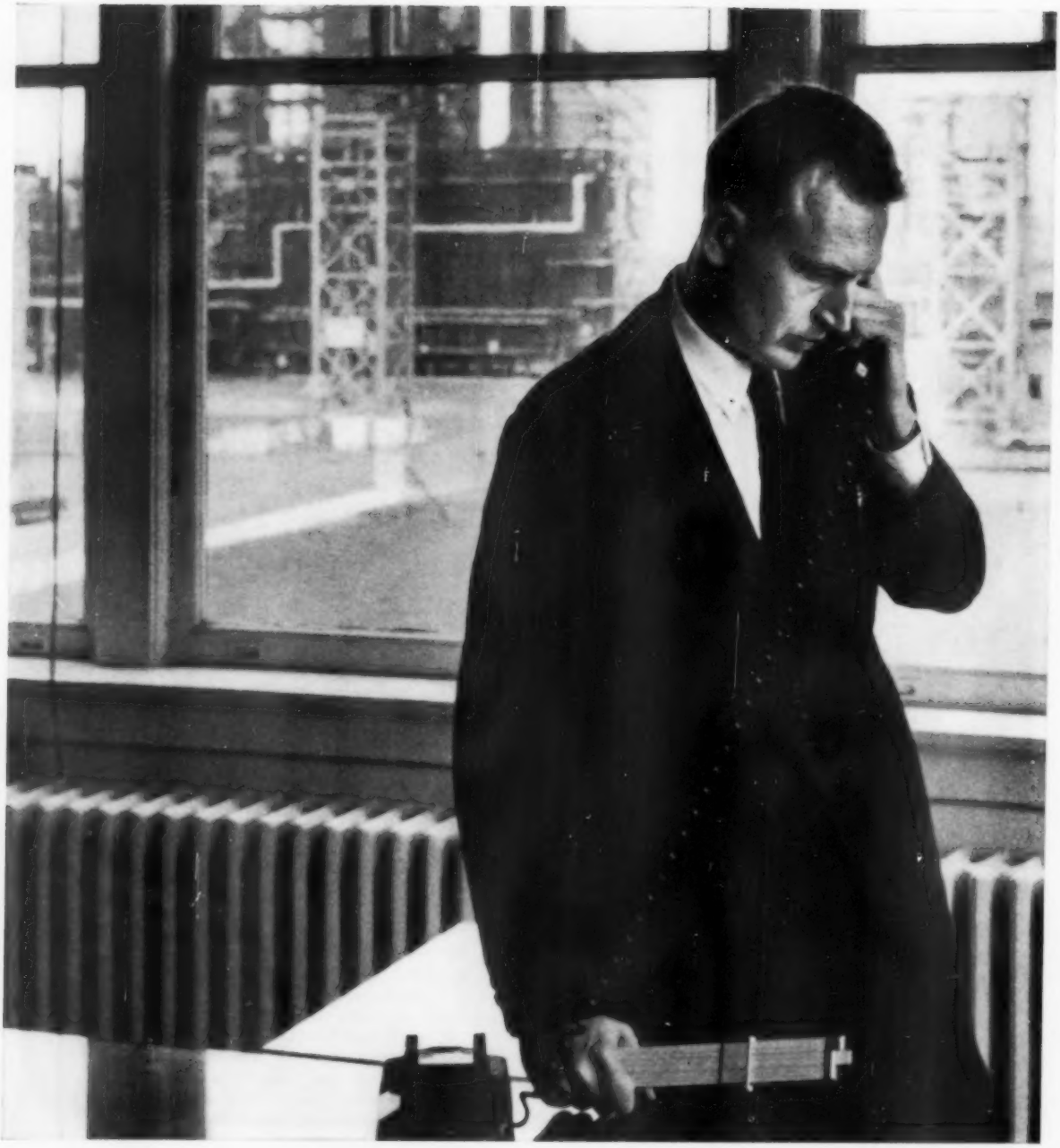
Reynolds Aluminum Oil Country Pipe is available throughout the oil fields at leading supply stores. It is offered in a full range of standard diameters and wall thicknesses.

For details on how this lightweight, strong pipe can cut your operating and maintenance costs, contact your local Reynolds branch office, listed under "Aluminum" in the phone book. Or write *Reynolds Metals Company, P.O. Box 2346-CR, Richmond 18, Virginia.*

Write today for full information. Ask for free booklet on Reynolds Aluminum Oil Country Pipe.

REYNOLDS ALUMINUM

Watch Reynolds new TV shows—"WALT DISNEY PRESENTS" and "ALL-STAR GOLF"—every week on ABC-TV.



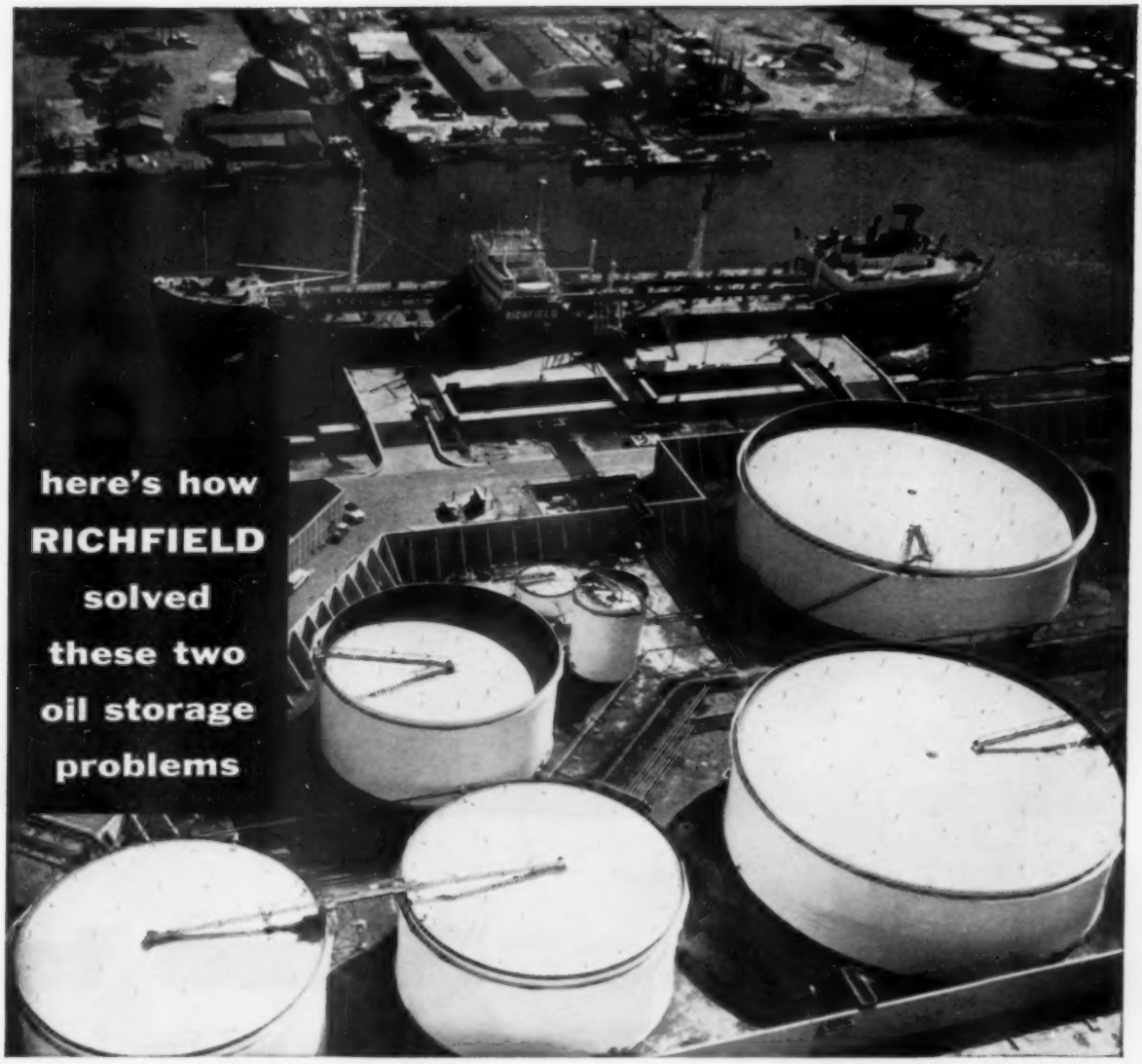
"Productivity is the end result of four factors working together effectively: labor, management, capital, and technology. No one or two can produce alone – all four are needed. And a reasonable balance among all four must be achieved constantly. To maintain this balance in our complex world today requires more knowledge, more understanding, more creativeness and more objective thinking on the part of more people. Education should lead towards this result, and the broadly trained scientific college graduate is certainly one of the key figures in the picture."

M. J. Rathbone, President, Standard Oil Company (New Jersey)

Esso

STANDARD OIL COMPANY (NEW JERSEY)

AND AFFILIATED COMPANIES



1. Fire Hazard 2. Vapor Loss

Here is an investment by Richfield Oil Company that pays off in safety and conservation. It is a seven-tank addition to Richfield's Marine Terminals that adds half a million barrels capacity. The tanks, built by General American, are equipped with Wiggins Floating Roofs with Wiggins Safety Seal that stops vapor loss and protects from rim fires.

Wiggins Double-Deck Floating Roofs with the Wiggins Safety Seal, reduce vapor space under the circumferential fabric to an absolute minimum. This practically eliminates losses due to thermal breathing and serves to prevent rim fires. The fabric is of a new, long-lived type and a special weather-hood protects it from the sun. The seal mechanism is always out of the liquid and the corrosive vapor space. Only the Wiggins Safety Seal gives you all these advantages.

PLATE & WELDING DIVISION
GENERAL AMERICAN
TRADE MARK

PLATE & WELDING DIVISION
GENERAL AMERICAN TRANSPORTATION CORPORATION
135 South LaSalle Street, Chicago 90, Illinois
Offices in all principal cities
It pays to plan with General American

E. W. Sandygren, President of Inland Petroleum Transportation, says: "In our business, time is of the essence. Customers such as airports, processing plants and ship-loading stations can't *wait* for deliveries. Hot cargoes must be delivered without excessive temperature loss. All this calls for motive power which is dependable and has a high degree of availability."

"Time is so Inland Petroleum

Inland Petroleum Transportation Company, of Seattle, Washington, operates a fleet of 43 highway vehicles, providing highly efficient motor-truck transportation for a wide variety of products in Washington, Oregon, Idaho and the Canadian Province of British Columbia.

All 43 of Inland's hauling units (32 full trucks pulling trailers and 11 truck-tractors pulling semi's) are powered with General Motors "6-71" Diesels.

Carl R. Seaberg, Maintenance Superintendent of IPT, gives his reasons for Inland's power choice:

"I have always liked GM Diesels. Other Diesels seem 'logy' in comparison. In addition, engine parts are highly interchangeable and are not heavy. Our mechanics can handle them with ease. Maintenance costs for GM Diesels are definitely lower than for competing engines. *Our oldest GM engine, purchased in 1939, is still going strong.*"

2,000,000-mile service!

Round trips for the IPT trucks vary from 300 to 1,100 miles—largely through mountainous terrain. Since 1939 one GM Diesel-powered unit has rolled up nearly 2,000,000 miles; another 1,904,000 miles since 1940; another 1,500,000 miles since 1941 and two others over 1,600,000 since 1942.

Total maintenance cost—4½¢ per mile

Intervals between overhauls are approximately 225,000 miles in tough mountain service. The well-equipped IPT shop uses "unit replacements" to help

One of Inland's truck-and-trailer combinations pauses beside the latest in jet airliners—the Boeing 707 Jet Transport at the Boeing plant in Seattle. The engine in this truck has a total of 1,900,000 miles since Inland purchased it from Detroit Diesel and 225,000 miles since its last major overhaul.

"of the essence"...

standardizes on "Jimmy" Diesels!

assure high availability of vital equipment. Only 4½¢ per mile is required for total maintenance of truck, engine, trailer and tank.

"Jimmy" Diesels available for any make truck

Latest version of the time-proved GM 2-cycle Diesel, the new "71E" engines with 4-valve heads, new "fire-ring" pistons and new injectors are producing the best mileage in Detroit Diesel history—and they're available for any make truck 26,000 GVW and up. The "6-71E" delivers 210 h.p. at an easy-stroking 2,100 r.p.m.; the "4-71E," 140 h.p.*

See your GM Diesel distributor about repowering your present equipment. When you're in the market for new trucks, ask for this great new GM "71E" Diesel. And if the truck you choose isn't immediately available with a "Jimmy," turn your truck over to the GM Diesel distributor for a "71E" installation.

*New GM *Turbopower* Diesels deliver even higher power with little increase in size or weight: "6-71T," 236 h.p.; "4-71T," 171 h.p.

Now—more than ever—*it pays to standardize on GM Diesels*—available in 1485 applications of power equipment built by more than 175 manufacturers. Parts and Service *Worldwide*.

GM
GENERAL MOTORS
DETROIT DIESEL POWER

DETROIT DIESEL ENGINE DIVISION OF GENERAL MOTORS, DETROIT 28, MICHIGAN

Regional Offices: New York, Atlanta, Detroit, Chicago, Dallas, San Francisco. In Canada: GENERAL MOTORS DIESEL LIMITED, London, Ont.

Announcing the

IBM

7070

DATA PROCESSING SYSTEM

• **First of IBM's line of fully transistorized data processing systems is the new IBM 7070—the most powerful and completely balanced system in the medium-scale computer field. It combines, for the first time in a solid-state system, higher storage capacity, faster computing speeds, new high-speed input-output units and a complete programming system.** ***In short, the IBM 7070 gives more performance per dollar than any system in its class.***

The SYSTEM: Transistor design lowers initial cost, minimizes cooling power and maintenance needs. "Building block" design grows as you grow. Other exciting features: IBM 7070 "reads," "writes," computes simultaneously; provides "automatic priority processing" for most economical use of system time. Ninety-nine built-in indexing words—more than in any other system—mean fewer operating instructions, faster, simpler programming. RAMAC® files provide immediate access to data.

The SERVICE: Unmatched IBM systems know-how is part of every IBM 7070 "package." From education of your personnel to top-notch service engineering, from program planning to testing—IBM men and methods stand by you to assure profitable operation as fast as possible. In addition, with the IBM 7070 you will receive a library of advanced programs at no extra cost!

The SAVINGS: Major design breakthroughs make possible lower lease or purchase prices, lower operating costs. For example, the IBM 7070 will sort at least 30% more economically than other computers. And equally important are the savings you make through added efficiency and more complete management information with the IBM 7070.

For further information, call your local IBM representative. Ask for free booklet, "IBM 7070." Or write: International Business Machines Corporation, 590 Madison Avenue, New York 22, N. Y.

IBM **DATA PROCESSING**

SPECIAL INVITATION TO YOU . . .

Shop at your SUPPLY STORE for AMERICAN IRON products!

It's a good idea to shop and buy ALL your equipment and necessary services through your SUPPLY STORE. This important part of our Oil Industry . . . the SUPPLY STORE, stands ready to serve you day by day, twenty-four hours a day, courteously and efficiently.

Come in and see the complete stock of AMERICAN IRON products on display at YOUR SUPPLY STORE.

BE SURE IT'S THE BEST . . . SPECIFY AMERICAN IRON

35 YEARS EXPERIENCE IN DESIGNING AND MANUFACTURING OIL FIELD EQUIPMENT

Another AMF Product
PETROLEUM EQUIPMENT

AMERICAN IRON & MACHINE WORKS COMPANY, INC.
518 North Indiana Avenue • Oklahoma City, Oklahoma
Subsidiary of AMERICAN MACHINE & FOUNDRY COMPANY

AMERICAN IRON & MACHINE WORKS CO. INC. • OKLAHOMA CITY •

Newly designed
Type H Motor Control

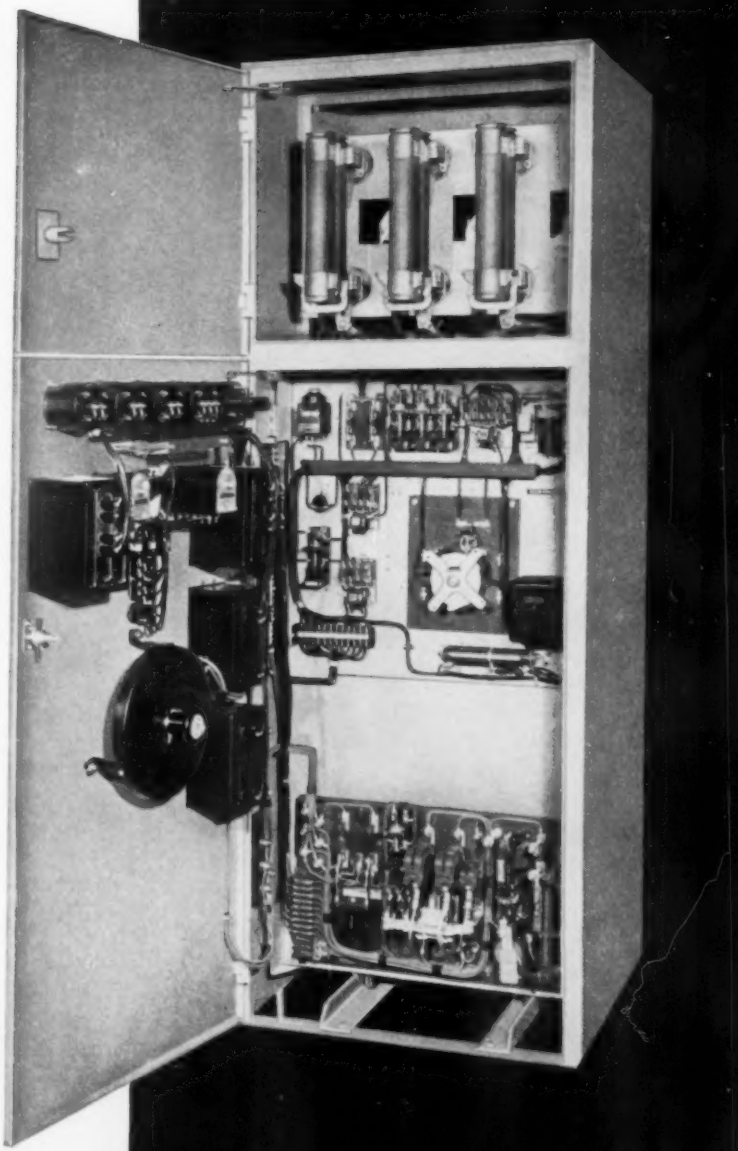
More room for optional features

Now, with Allis-Chalmers high voltage control, you get more panel space for additional components.

Meters, pushbuttons, instruments, rheostats, indicating lights, relays, and other components can be installed—thanks to the ample space available on both the outer door and inner barrier.

Along with more room, this new A-C design is front accessible, has smaller cabinet size, provides ultimate in protection for men and machines, and has been completely tested.

For more information on this engineering advance, contact your A-C® office or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.



All this area on Allis-Chalmers new Type H motor control is available for optional features. In many applications, this extra space eliminates the need for an extra cabinet.

Removable panel, on which control devices are assembled, is mounted on inner barrier. Entire panel may be quickly removed for inspection and maintenance.

ALLIS-CHALMERS A-C

A-5519

QUALITY YOUNGSTOWN SERVICE

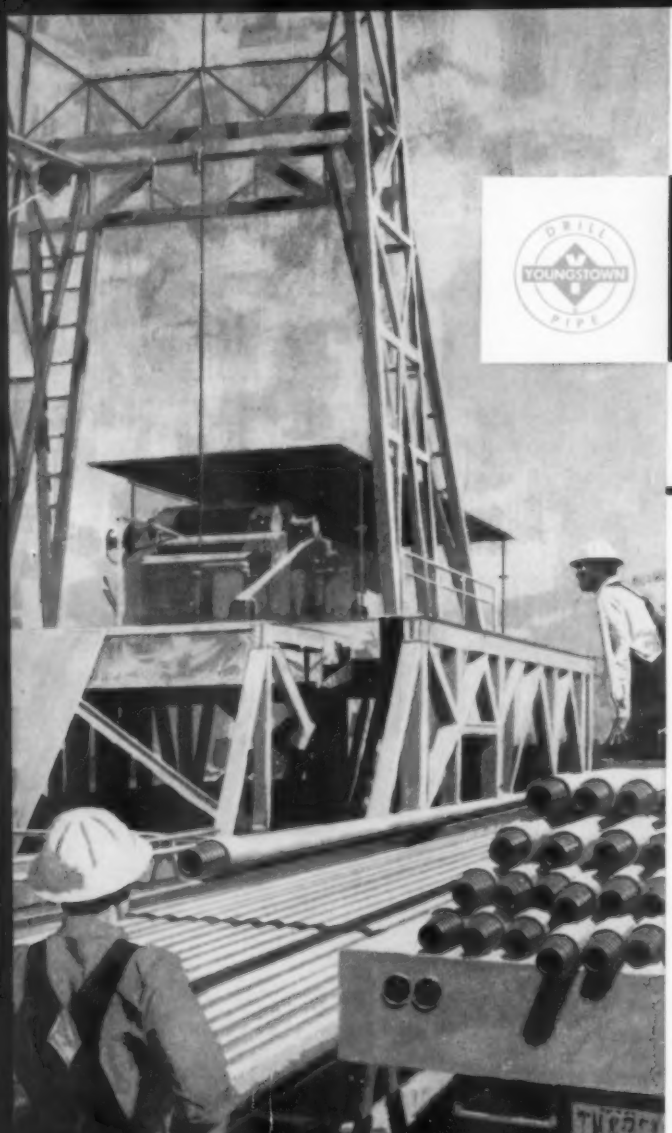
CEco.

LET'S TALK PIPE

World's largest rotary billet heating furnace at Youngstown's new Indiana Harbor plant . . world's most modern tube mill.

..Go CONTINENTAL-EMSCO

..THE PIPE WAREHOUSE OF THE **OIL WORLD**



Youngstown pipe

ENGINEER
FOR THE

LET'S TALK DRILL PIPE

..2⅜" through 5½" API sizes .. upset for flash weld .. API and special threads

GRADE D	YIELD STRENGTH 55,000 psi
YOLOY	YIELD STRENGTH 70,000 psi
GRADE E	YIELD STRENGTH 75,000 psi
X-95	YIELD STRENGTH 95,000 psi
P105	YIELD STRENGTH 105,000 psi

Developed by Youngstown and included in thes five API grades are lightweight drill pipe to in crease rig depth range and special fatigue, stres and torque resisting pipe for deep holes. Each i designed for more rotating hours under specifi drilling conditions. This wide selection lets yo drill with Youngstown drill pipe to all depths an in all formations with maximum efficiency, maximum economy.

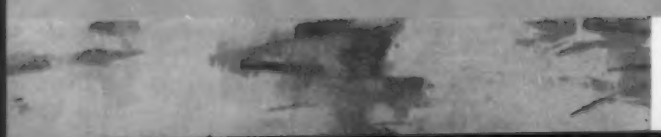
This drill pipe is made for all types of tool joints so specify the one you want .. and have to Youngstown quality too.

LET'S TALK TUBING

.. API grades H-40, J-55, N-80 and P-105

Youngstown tubing is available in all API size and grades for every well condition. Constan quality-control assures fast make-up, high join strength and smooth, free-flowing interior walls

These familiar ORANGE BA



pipe is delivered..

EERED
IE JOB

Today's pipe strings must be *designed for the job* for maximum safety and economy. Here's where your Continental-Emsco and Youngstown *pipe team* steps in. Your C-E man *knows* local drilling conditions . . your Youngstown pipe engineer *knows* pipe. Together, they can recommend the pipe grade best suited for you . . performancewise . . pricewise. And Continental-Emsco intransit stocks plus strategically placed *local* pipe stocks assure fast delivery.

LET'S TALK CASING

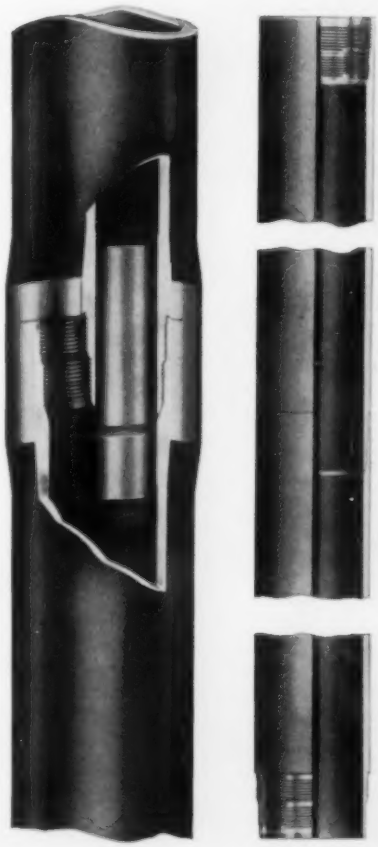
. . Complete range of sizes . . API grades H-40, J-55, N-80 and P-110 made in the world's most modern tube mill

SPEEDTITE . . *Streamlined joint developed for today's greater depths and pressures.*

SPEEDTITE, proved for over 20 years, gives full clearance with the extra strength needed to support heavy deep-well casing strings. SPEEDTITE joints provide 100% pressure seal against both internal and external pressures . . completely leak proof up to and beyond the casing's yield point.

FLUSH JOINT . . *Designed for tight holes and for liner pipe installation.*

FLUSH JOINT is an extremely strong casing joint. Because of its positive shoulder action, these casing joints transmit high torque loads without creeping and can be broken-out and made-up repeatedly without damage to the threads. Smaller OD allows use of one size larger FLUSH JOINT casing than with collared casing. In sloughing or caving formations, the running speed of FLUSH JOINT is of great importance. It can be run through packers at high speeds, under high or low pressures without damaging them.



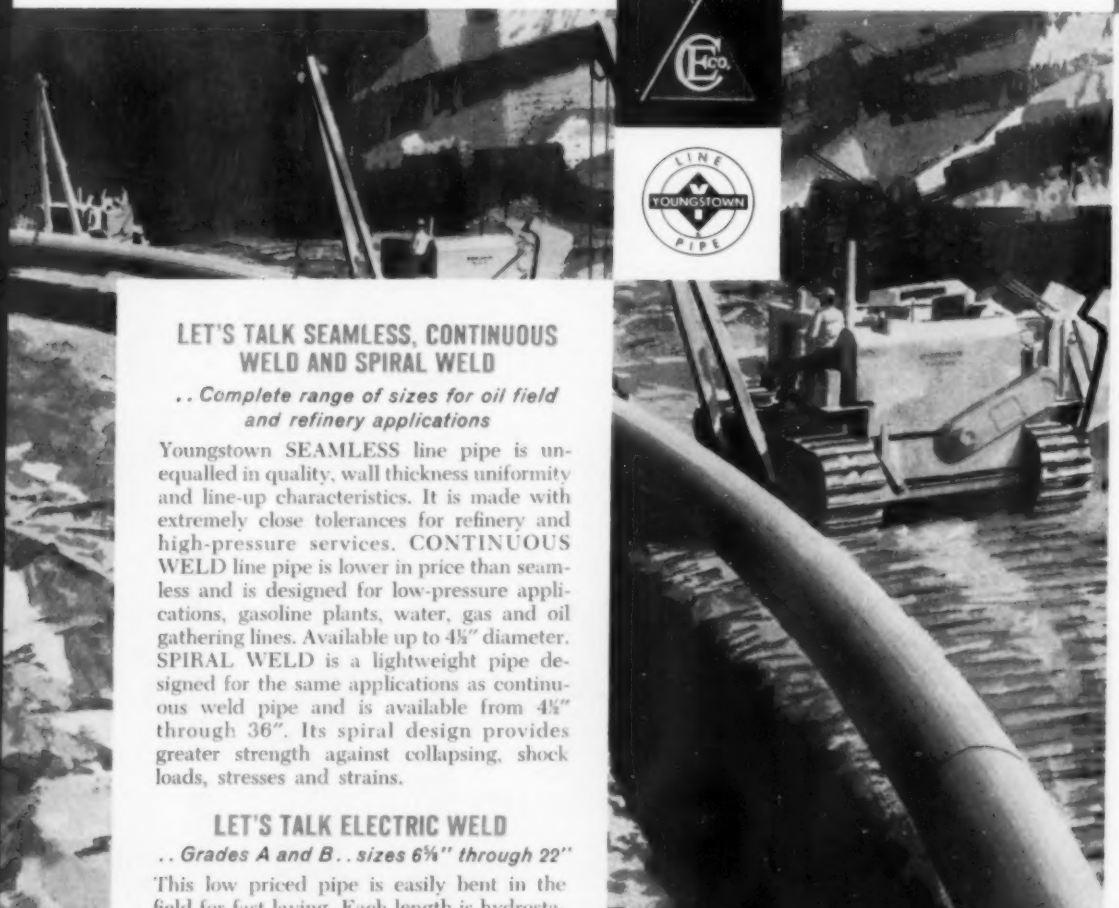
SPEEDTITE FLUSH JOINT

ANDS say TOP QUALITY

KEEPING OIL AND GAS ON THE MOVE

Your Continental-Emsco and Youngstown *pipe team* stands ready to recommend the right pipe for your pipe line installation, whether for transmission lines, gathering lines or water-flood piping systems. This team is backed by a complete range of grades and sizes in all wall thicknesses and in single or double random lengths.

LET
SPE



LET'S TALK SEAMLESS, CONTINUOUS WELD AND SPIRAL WELD

. . Complete range of sizes for oil field and refinery applications

Youngstown SEAMLESS line pipe is unequalled in quality, wall thickness uniformity and line-up characteristics. It is made with extremely close tolerances for refinery and high-pressure services. CONTINUOUS WELD line pipe is lower in price than seamless and is designed for low-pressure applications, gasoline plants, water, gas and oil gathering lines. Available up to 4½" diameter. SPIRAL WELD is a lightweight pipe designed for the same applications as continuous weld pipe and is available from 4½" through 36". Its spiral design provides greater strength against collapsing, shock loads, stresses and strains.

LET'S TALK ELECTRIC WELD

. . Grades A and B . . sizes 6⅝" through 22"

This low priced pipe is easily bent in the field for fast laying. Each length is hydrostatically tested to insure 100% resistance to leakage. It is furnished with plain or bevelled ends as required for welding joints or for various types of mechanical couplers. Long lengths reduce welding costs.

FOR ALL YOUR TU

LET'S TALK SPECIALTY ITEMS

Talk "special piping applications" with your Continental-Emsco pipe men. Their recommendations of special pipe materials will solve sweet, sour, salt water corrosion and paraffin problems. Special pipe diameters and fittings are available for unusual gathering lines, dual-zone pumping, water flooding and other applications. Let C-E tackle your tubular problems with experience, quick delivery and warehouse facilities.

FIBERCAST .. *A high-pressure, high-temperature modern pipe for use in oil fields, chemical and petro-chemical plants*

FIBERCAST is made in API diameters and up to 21′ lengths. It is lightweight and furnished with the most complete line of fittings ever offered in a non-metallic pipe line for fast, leakproof hook-ups.

Drawing shows the glass cage made of continuous fibers braided into a glass sleeve of multiple seamless layers. This cage gives FIBERCAST its unusually great axial strength. Inner epoxy resin core is centrifugally cast to impregnate the cage as well as form a corrosion resistant, free-flow interior wall.

These plastic pipes are available in all standard iron pipe sizes .. up to 20′ in length. They have long lasting qualities in low-pressure, low-temperature, corrosive installations. GREEN TRIANGLE X-TRUDE, made of high-grade extruded thermoplastic, is lower in price and more flexible than PVC pipe. GREEN TRIANGLE PVC is a heavy-duty, polyvinyl chloride pipe .. unexcelled in resisting corrosion. It is one-half the weight of aluminum .. one-sixth the weight of steel.

GREEN TRIANGLE X-TRUDE AND PVC PIPE ..

Designed for low-pressure, low-temperature flow lines, salt water disposal

Aluminum pipe is highly recommended for gathering lines where its resistance to corrosion gives it exceptionally long life. Its light weight and flexibility make it easy to lay. Tool pushers find that aluminum pipe, used for temporary fuel and water lines, is fast laying and economical because of its light weight.

ALUMINUM PIPE ..

Light weight .. corrosion resistant

TUBULAR NEEDS ..

LET'S TALK PIPE SUPPLY AND SERVICE

We know pipe. We have the pipe grade and size to meet every oil field piping need efficiently.. economically. For *pipe engineering* Youngstown field engineers working in conjunction with C-E men are available to make pipe recommendations for those special, ticklish jobs. Continental-Emsco stores are handy, convenient supply points for valves, fittings, gauges, pumps, compressors and the thousand and one items needed for pipe installations and servicing.

CONTINENTAL-EMSCO..

Supplies pipe to all branches of the petroleum industry.. **WORLDWIDE**

CANADIAN STOCKS

Continental-Emsco is also a distributor for Mannesmann Tube Company Ltd. in Canada.

INTRANSIT STOCKS

At strategic locations, pipe shipments are trucked to your lease for fast delivery.

PLANT LOCATIONS

Youngstown's tube mills are located at Indiana Harbor, Ind. and Youngstown, Ohio.

CONTINENTAL-EMSCO

Serving the Oil and Gas Industries ... Worldwide

CONTINENTAL EMSCO COMPANY • A Division of The Youngstown Sheet and Tube Company • General Offices: Dallas, Texas
Export Division: 40 Rockefeller Plaza, New York, N.Y. • Continental-Emsco Company Limited • General Offices: Calgary, Alberta, Canada
Continental-Emsco Company C.A., Caracas, Venezuela • Plants: Los Angeles, Houston, Cleveland, Texas, St. Albans, York, England • Representatives in All Principal Oil Fields of the World

T830

..Go CONTINENTAL-EMSCO

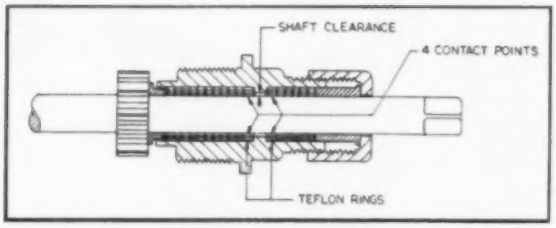
▶ ▶ ▶ New Equipment Section

This week's SHOWCASE features . . .

Combination tools for well service

. . . allow shooting, testing, and squeezing all in one trip, the maker claims. They can be useful in acidizing, squeeze cementing, fracturing, casing testing, casing perforating, and collar locating. The FFC tools are made for work in wells in the size range of 4¾ to 8⅝ in. As the illustration shows, the collar locator and casing perforator are used with the packer. The packer is full-opening to API tubing sizes and permits through-tubing services to be performed.

The collar log can be made going in or coming out of the hole with the drill pipe or tubing and accessory tools attached. The casing perforator is an expendable type. It can be inserted in the drill pipe or tubing at the surface and pumped down the well with the rig pump or cementing unit. Actuated hydraulically, the perforator cannot be accidently fired on the surface, the maker says. **Write or call: Oil Well Cementing Co., 11923 South Regent View Avenue, Downey, Calif., for details on Free Flow combination tools.**



Teflon shaft-centering rings

. . . prevent metal-to-metal contact between the shaft and stuffing box on Daniel Junior and Senior orifice fittings. The rings are self-lubricating, nonadhesive, and inert to most chemicals. They are now standard equipment on all Junior and Senior fittings in sizes from 2 through 24 in., 150 to 1,500 lb. ASA, and in sizes from 2 through 6 in., 2,500 lb. ASA.

The rings are designed to assure free shaft rotation even after long periods without operation. **Write or call: Daniel Orifice Fitting Co., P. O. Box 19097, Houston, for details on Teflon shaft-centering rings.**

B.s. and w. monitor has two ranges

. . . available—0 to 2% and 0 to 10%. The Wat-R-Larm for b.s. and w. detection in crude oils normaliy comes with a full-flow, 4-in. NPT, flanged probe. A 1¼-in. NPT bypass probe is available too.

A bridge type of circuit is used to detect changes in the probe capacity. This circuit is fail-safe to indicate high b.s. and w. content for equipment failure. The maker's standard equipment includes time delay and heavy-duty switch contacts.

The probe may be located up to several hundred feet from the control unit and any good grade of electrical cable can be used. **Write or call: Jarco Services, Inc., 415 South Kenosha, Tulsa, for details on Wat-R-Larm b.s. and w. monitor.**

Send this **Showcase Coupon**

to the Manufacturer of the item in which you are interested. See name, address, and equipment name and/or model, in bold-face type at end of description.

NAME AND/OR MODEL NUMBER.....

.....

.....

Described in OIL AND GAS JOURNAL - Issue of October 6, 1958

NAME.....TITLE.....

COMPANY.....

ADDRESS.....

CITY.....STATE.....

DATE.....

SHOWCASE . . .

New Equipment

Gas turbine powers crew boat

. . . for offshore use at a cruising speed of 35 m.p.h. The 55-ft. boat is powered by two Solar Jupiter 500-hp. gas turbines. The two turbines together weigh only 4,400 lb. Advantages cited for the gas-turbine power source include light weight and no engine vibration.

The crew boat can accommodate as many as 25 persons. It operates on diesel fuel but the gas turbines can be simply adjusted to use other fuels, including gasoline, jet fuel, kerosine, and natural gas. **Write or call: Sewart Seacraft, Highway 90 West, Berwick, La., for details on crew boat.**

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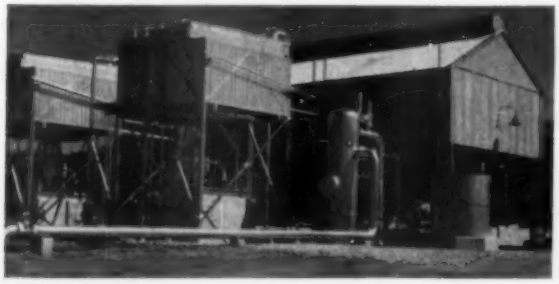


Ebullient cooling medium developed

. . . for use in cooling large, internal-combustion engine stations like the one shown. Called Dowtherm 209, the product is expected to overcome the problems of ebullient cooling caused by cold weather.

It gives freeze protection both in the engine and in the condensate-return line. The maker recommends use of a 53% by weight solution in water. This mixture gives freeze protection down to about —45° F.

Physical properties include an azeotropic boiling point of 209° F., pour point of —50° F., flash point of 122° F., viscosity of 6.5 centipoises, and a specific gravity of 0.9935. **Write or call: Dow Chemical Co., Midland, Mich., for details on Dowtherm 209, cooling medium.**

•

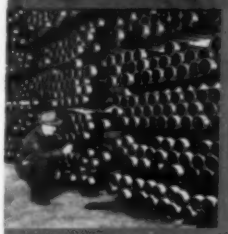
Motor operates under water

. . . allowing the insulation system of its windings, bearings, and magnetic components to be totally immersed. The "wet" motor employs a new insulation system using irradiated polyethylene.

A wide-range of applications are expected throughout industry. The motor offers advantages for boiler-circulation pumps as the need for a pump seal is eliminated. Water from the pump can circulate through the internal electrical and mechanical components of the motor.

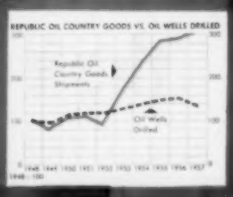
The "wet" motor functions efficiently in water under pressures to 3,000 psi. Motors of 250 and 350 hp. are available. Potential uses also include deep wells under high pressure. **Write or call: General Electric Co., Schenectady 5, N. Y., for information on underwater motor.**

REPUBLIC STEEL
...FASTEST GROWING MAJOR IN CASING AND TUBING BECAUSE...

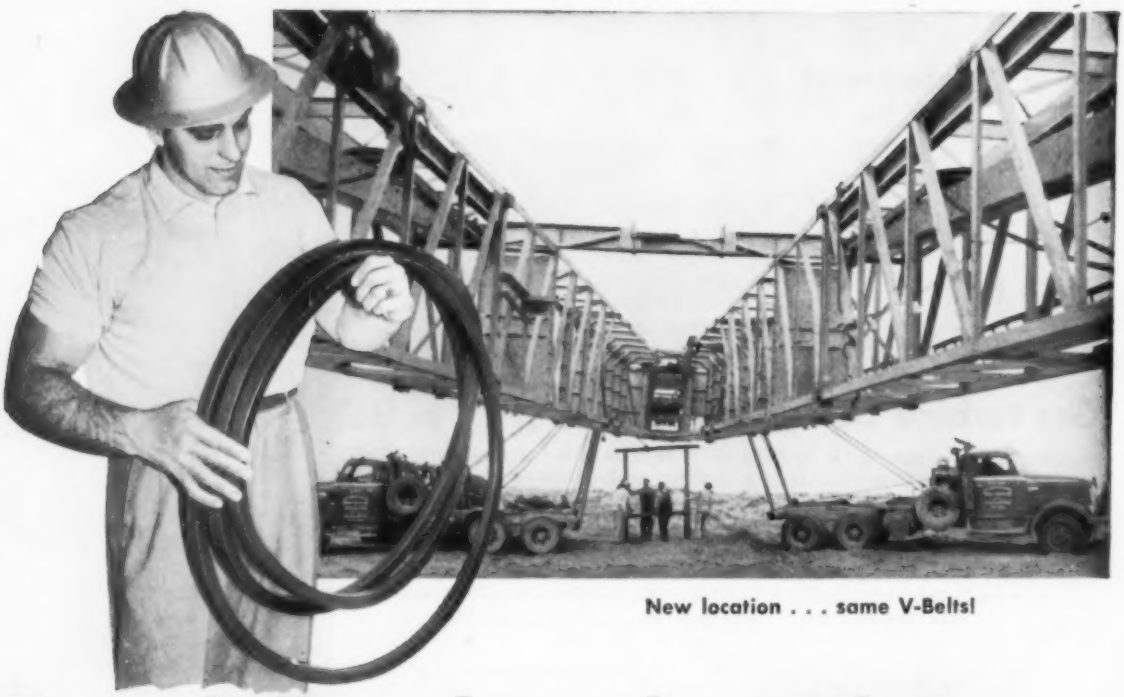


1. EXPERIENCE...
Republic people know the oil industry as well as they know steel. Their half-century of success has made Republic the fastest-growing "major" in Casing and Tubing.

Republic has tripled Casing and Tubing production in the last ten years. Seamless and welded. Field stocks strategically located. Specify "Republic".



REPUBLIC STEEL
CLEVELAND, OHIO



New location . . . same V-Belts!

More drillers depend on Rib-Tops than any other V-Belt in the world

Gates Rib-Tops are the only V-belts designed specifically for mud pumps. Superior design and construction mean longer life . . . less down-time . . . much lower belt replacement expense. Yet Rib-Tops cost no more than ordinary belts of comparable ratings.

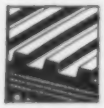
Both Standard and Super Rib-Top are available at your oil field supply house.

For Toughest Drives Use *Super* Rib-Top

With 40% greater horsepower capacity, Super Rib-Top easily handles overloads. Fewer belts and narrower sheaves solve space and weight problems.

The Gates Rubber Co., Denver, Colo.

No other V-Belt has ALL these advantages



1. Stabilizing ribbed tops (U.S. Pat. 2548135) are exclusive with Gates. They dampen vibration, protect top of belt from damage, keep belt running smoothly over idler-equipped mud pump drives with no side whip.

2. Flex-Weave Cover (U.S. Pat. 2519590) A Gates exclusive: provides greater flexibility with far less stress on fabric. Cover wears longer . . . increases belt life . . . more power available to driven machine.

3. Concave sidewalls (U.S. Pat. 1813698) Concave sides (Fig. 1) increase belt life. As belt bends, concave sidewalls become straight, making uniform contact with sheave groove (Fig. 1-A). Uniform contact means less wear on sides of belt . . . far longer belt life.

4. Tougher, more resilient cords are able to absorb the severe pulsations of mud pumps; easily handle peak loads.

TPA 300A

The Mark of Specialized Research

Gates

Gates Rib-Top Vulco Rope

DEVELOPED ESPECIALLY FOR MUD PUMP DRIVES

Pipe detector does three jobs

. . . in pipeline construction and operation. The Model PD Pearson detector promises to be extremely useful. It can locate discontinuities in protective pipe coatings down to minute perforations of the wrappings in pipe buried at normal depths. It can locate these holidays from the surface of the ground, without uncovering the pipe when the soil around the pipe is fully compacted and has moisture.

The detector can also locate electrical shorting between two pipelines or between a pipeline and another metal structure. Too, it can trace an individual pipeline, including its branches, through a maze of buried pipe in city streets when the systems are not electrically connected, even when the line being checked is closely paralleled or stacked with other lines in a trench.

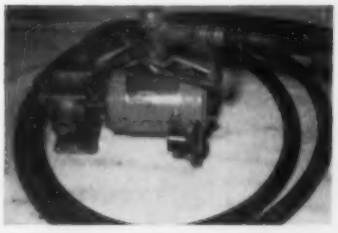
The receiver is so small that it can be worn on the belt. Transistors and filters screen out power-line noises, etc. A mercury battery powers the receiver.

Including the carrying case and without the storage battery, the unit weighs less than 20 lb. **Write or call: Tinker & Rasor, P. O. Box 281, San Gabriel, Calif., for details on Model PD Pearson detector.**

Four-Way water flood manifold valve

. . . enables a producer to hook up four wells into one valve with one well on test and the other three on production. The multiport valve has one 4-in. commingling outlet, four 2-in. inlet ports, and one 2-in. test port. Any of the four inlets can be put on test. Simply rotate the handle to the right position, the maker says.

The valve locks in any test position. Measuring 12½ in. high and 8¾ in. wide, the valve weighs about 60 lb. Body, plug, and handle are Meehanite cast iron. Seals are Hycar O-rings. Packing can be either Teflon or Marlex. Most makes of electric or pneumatic actuators can be had. Working pressure of the standard design valve is 125 psi. But special designs are obtainable with a working pressure of 600 psi. **Write or call: Enardo Mfg. Co., P. O. Box 1647, Tulsa, for details on 4-way manifold valve.**



Transfer pump powered by battery

. . . eliminates need to transfer fuels and other liquids by hand-operated pumps. The pump handles petroleum products, fresh or salt water, and other liquids that are noncorrosive

REPUBLIC STEEL
. . . FASTEST GROWING MAJOR IN CASING AND TUBING BECAUSE . . .

2. QUALITY . . .

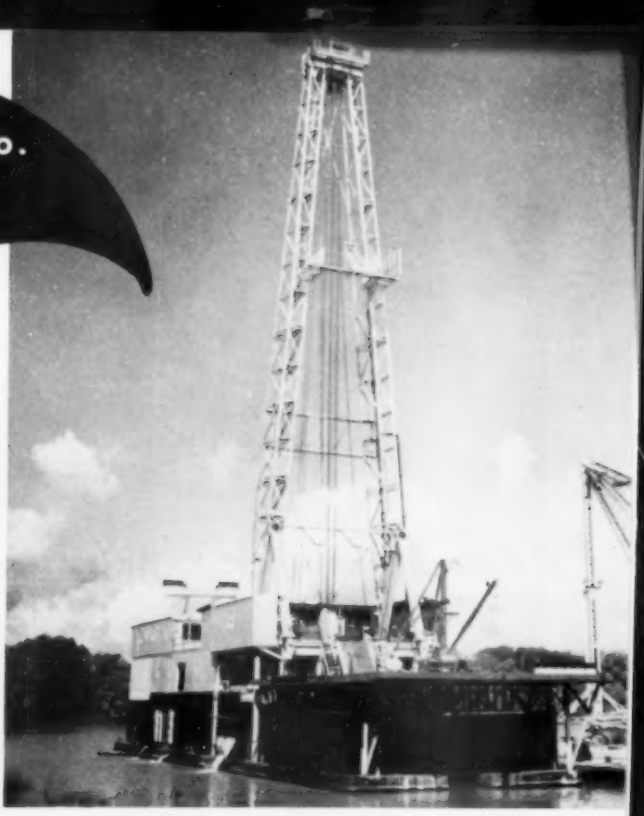
Republic's reputation for furnishing quality products year-in and year-out has been solidly built. Product quality has helped to make Republic the fastest-growing "major" in Casing and Tubing.

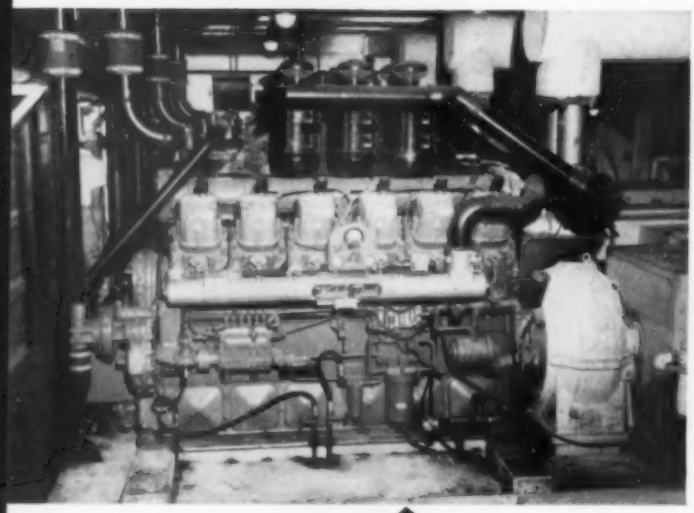
Republic has tripled Casing and Tubing production in the last ten years. Seamless and welded. Field stocks strategically located. Specify "Republic".

REPUBLIC STEEL

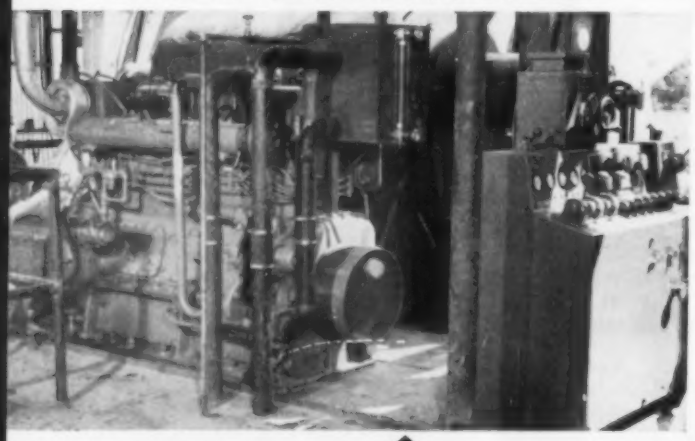
CLEVELAND, OHIO

NEW Two-R Drilling Co. BARGE No. 1





(drilling engines—drawworks and mud pumps)
Three Waukesha VLRDBSU Turbocharged 12-cyl. Diesels



(rotary table drive and catworks)
Waukesha NKDBSU Turbocharged Diesel

all-WAUKESHA POWERED

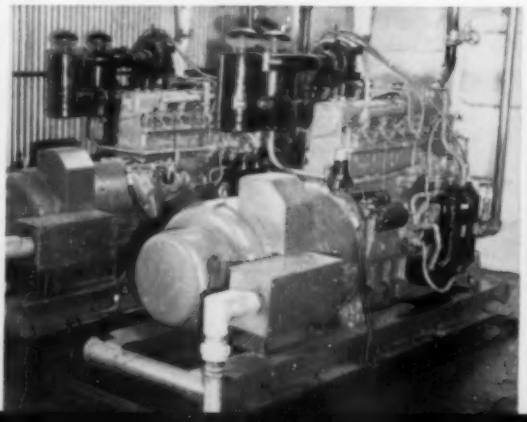
Recently commissioned at Morgan City, La., Barge No. 1 has a 25,000′ capacity drilling rig. The mast, 142′ high x 32′ at base, has 1,000,000 lb. lifting capacity. Barge is completely powered by Waukesha Diesel Engines, each of which has its own heat exchanger-surge tank system. The barge itself is 170′ long, 45′ wide, 12′ deep, with a substructure 24′ high; has living quarters for 22 men. It was built for Bethlehem Supply Co. by Reagan Tool Co. for delivery to Two-R Drilling Co. Reagan Equipment Co. supplied the Waukeshas. Get bulletins.

WAUKESHA MOTOR COMPANY, WAUKESHA, WISCONSIN
New York • Tulsa • Los Angeles

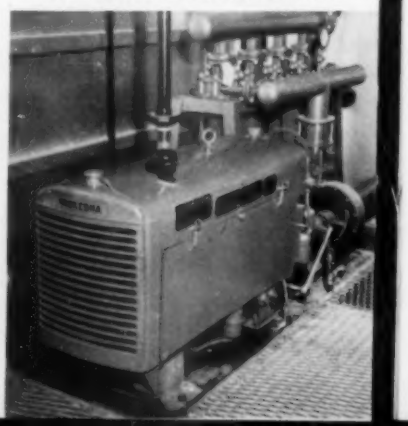
396

(mud mix pump)
Waukesha WAKDU Normal Diesel

(main electrical power) Two Waukesha WAKDBSU Turbocharged Diesel 125 KW Enginators



(de-sander unit)
Waukesha 190-DLCU Normal Diesel



New Equipment

to bronze valves or butyl-lined hose. It isn't damaged by foreign particles in the line.

The pump is operated by a car battery drawing 100 to 110 amp. It can be obtained for either 6 or 12-volt batteries. It is simple to install. Parts subject to wear are easily replaced. The pump is self-priming and push-button-controlled from the nozzle outlet.

Discharge hose size is ¾ in. Suction line is 1 in. Pump capacity exceeds 15 g.p.m. **Write or call: Transfer Pump Co., Osburn, Idaho, for details on transfer pump.**

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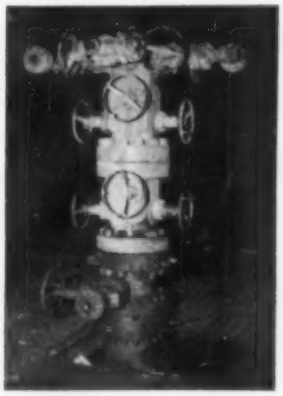
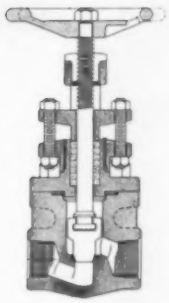


Quadruple-zone christmas tree

. . . for parallel strings developed. The quadruple tree employs a closed pressure system for complete control at all times using three solid, forged-steel blocks. One block is for the tubing-head spool, one is for the four master valves, and one is for the four tree valves.

The tubing-head spool is designed to receive, lock down, and seal four segmented tubing hangers. During the time the drilling controls are removed and the tree is installed, each of the locked-down, sealed hangers has a 30,000-psi. back-pressure valve installed in the hanger annulus. These are removed after the complete tree is installed and tested.

The solid, forged-steel blocks of the four master valves and the four tree valves are Cameron-type gate valves. They have stainless-steel seats which rotate a fraction each time the gates are opened and closed to distribute wear over the entire seating surface. **Write or call: Cameron Iron Works, Inc., 1000 Silber Rd., Houston, for details on quadruple-zone christmas tree.**



Hardened valve disk takes wear

. . . in this new round, bolted-bonnet, bolted-gland, globe valve for service at pressures from 150 to 800 psi. It's available with threaded or socket-weld ends in sizes of ¼ through 2 in.

The disk is 13% chrome stainless steel, hardened to give high resistance to wear and erosion. Valve body is forged steel with integral seats hard-faced with Stellite or similar material. Deep stuffing boxes are used to extend packing life. Gaskets are made of stainless steel, spiral wound, and asbestos filled to take high temperature and pressure. **Write or call: Henry Vogt Machine Co., Box 1918, Louisville 10, Ky., for details on general purpose globe valve.**

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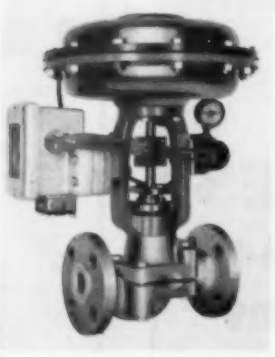
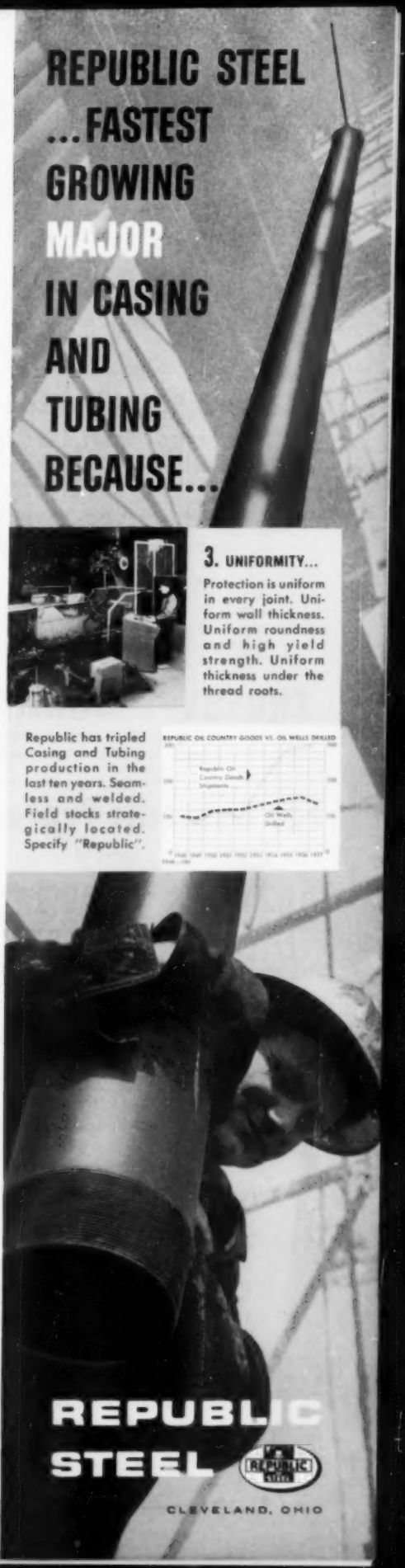
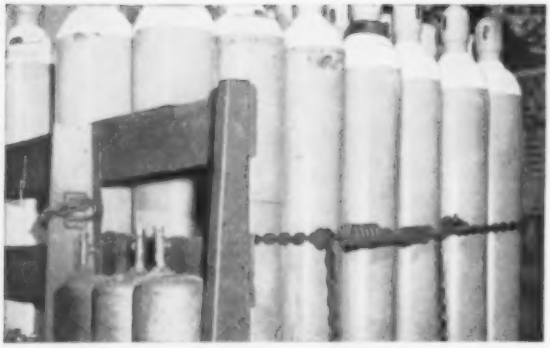


Valve operator uses no springs

. . . to function on this new Uniflow Type 1000 control valve. The motor operator uses preformed Buna-N Nylon diaphragms instead.

The body is a single-seat split type available in sizes of 1 through 6 in. in carbon steel, stainless steel, Monel, and Hastelloy C. The valve is expected to be valuable for high pressure drops, flashing service, and chemical and slurry handling. **Write or call: Uniflow Valve Corp., 19 Quine Street, Cranford, N. J., for Bulletin 117.**


REPUBLIC STEEL
...FASTEST
GROWING
MAJOR
IN CASING
AND
TUBING
BECAUSE...
3. UNIFORMITY...
Protection is uniform in every joint. Uniform wall thickness. Uniform roundness and high yield strength. Uniform thickness under the thread roots.
Republic has tripled Casing and Tubing production in the last ten years. Seamless and welded. Field stocks strategically located. Specify "Republic".
REPUBLIC STEEL
CLEVELAND, OHIO



LEBUS Snubbing Load Binder secures "SOLID" loads!

Solid loads—gas cylinders, rod cans, pipe, steel, stone, etc., stay put on your truck when they're secured with Lebus Snubbing Load Binders. Re-tightening of chain after load has settled isn't necessary. Rugged coil spring absorbs shocks—maintains full binding tension—dropping back a link is never required! Short throw handle ideal in confined areas. Many features—drop forged binder, ball and socket swivel, locking handle—make Lebus Load Binders first choice of profit-safety conscious truckers. See, *test* this popular binder at mill supply, industrial or construction equipment distributors everywhere. For help with your binding problem, write:

CROSBY-LAUGHLIN *Division*

AMERICAN HOIST & DERRICK COMPANY
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RENTAL TOOLS AND SERVICE

WASHOVER DRILL COLLAR SPEAR

PHONE 4-6623

TRI-STATE OIL TOOL CO., INC.

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For Cathodic Protection.. only ZINC ANODES

Have Long Life and are Self-Regulating

Unlike other metals sometimes used for cathodic protection, zinc anodes have an expected life of a minimum of fifteen years. Zinc anodes are self-regulating and require no current regulating resistors to meet the load demand, whether high or low.

These are important reasons why American Zinc Anodes are first choice for cathodic protection in the oil and gas industry. Your inquiries invited.

Manufactured by:

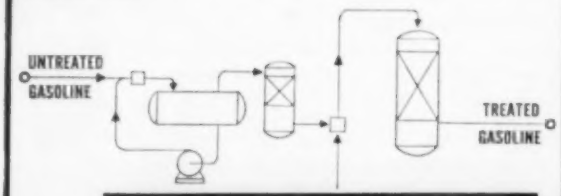
American Zinc, lead & smelting company

Distributed by:

cathodic protection service

HOUSTON, TEXAS • TULSA, OKLA. • NEW ORLEANS, LA.
CORPUS CHRISTI, TEXAS • DENVER, COLO.

TC SWEETENING



TENNESSEE COPPER CHLORIDE

Tennessee's Copper Chloride was developed to effect efficient Mercaptans removal.

Place your confidence in a basic producer of Copper Chemicals.

CUPRIC CHLORIDE DI-HYDRATE

Other products of interest—
Ferric Sulfate—Copper Sulfate,
Copper Oxide—Sulfur Dioxide.

For samples make request on your company letterhead.

TENNESSEE TC CORPORATION
617-629 Grant Building, Atlanta, Ga.

SHOWCASE . . .

New Literature

Winches for all Willys vehicles

. . . are reviewed in new 12-page Bulletin J-1-58. Illustrated on the Willys jeep are front-mounted, bed-mounted, and rear-mounted winches. Two pages cover the heavy-duty double-winch industrial unit. Accessories illustrated are the power takeoff, a frame assembly, and wire reclaimer. Complete specifications are included for the nine winch models for Willys vehicles. **Write or call: Ramsey Winch Mfg. Co., Box 3067, Tulsa 8, for Bulletin J-1-58.**

New plastic piping material

. . . is discussed in a three-page engineering data bulletin now available upon request. Tagged Type II ABS, the pipe represents a development which removes some limitations and opens up newer and different uses for plastic pipe. The pipe is offered in four pressure ratings. Applications in oil fields and chemical processing are listed in the bulletin. Also included are physical and mechanical properties, chemical - resistance data, flow characteristics, and working-pressure charts. **Write or call: Southwestern Plastic Pipe Co., Box 117, Mineral Wells, Tex., for Type II ABS bulletin.**

Roller chains and sprockets

. . . are detailed in new 154-page Book 2657. It's written to serve as a practical textbook on the use of roller chain for both power transmission and conveyor service. The book contains typical installation conditions, formulas, charts, and diagrams to simplify selection of proper chains for any application. It's said to be the most comprehensive book written on roller chains and sprockets. "Keydexed" for easy reference, the book describes the selection, application, installation, lubrication, and maintenance of roller chains and sprockets for drives and conveyors. **Write or call: Link-Belt Co., Prudential Plaza, Chicago 1, for Book 2657.**

Kinematic flowmeter design

. . . is detailed in new Technical Bulletin 91-120 entitled Dimensionless Correlation of Coefficients of Turbine-Type Flowmeters. The bulletin discusses a proposed method for evaluating design of kinematic flow-meters of the turbine or propeller type. Experimental results are correlated over a wide range of fluid conditions and geometric variations. Coefficients are compared against those predicted from a one-dimensional design equation. Use of the proposed method can help you evaluate various designs. **Write or call: Fischer & Porter Co., 812 Jacksonville Road, Hatboro, Pa., for Bulletin 91-120.**

Packaged inert-gas-producing equipment

. . . is described in a new four-page brochure. It includes inert gas generators, carbon dioxide removal units, gas purifiers, gas drying equipment, compressors, and storage systems. These units can be used in petroleum production, transportation, and refining. **Write or call: Southwest Industries, Inc., P. O. Box 19392, Houston 24, for inert gas producing equipment brochure.**

New heat exchanger line

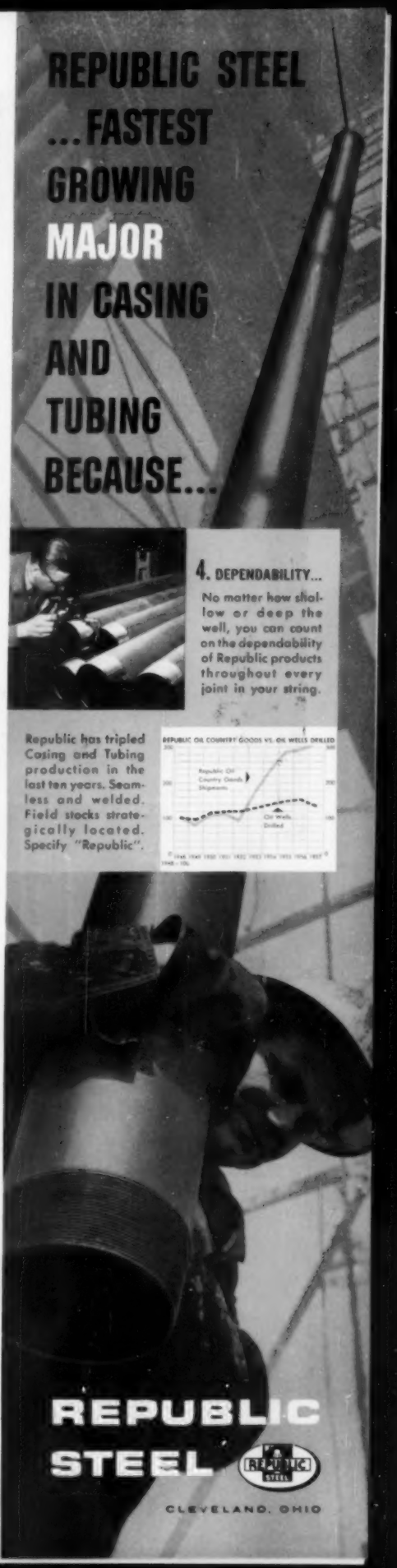
. . . is featured in Bulletin HT-20. It gives standard dimensions, materials, and engineering data on new steam fixed-bundle models. The heat exchangers have no gasket joints on the steam side. They feature large baffled steam-inlet connections. Stock diameters are from 6 to 19 in. Lengths are from 3 to 16 ft. New stainless-steel models offer effective resistance to corrosion plus high strength and thermal efficiency, the bulletin says. Stock diameters range from 2 to 10 in. with lengths from 8 in. to 6 ft. **Write or call: Yates-American Machine Co., Beloit, Wis., for Bulletin HT-20.**

Rotary gas pumps

. . . are detailed in new Bulletin XA-458. Now available in 18 sizes, the Type XA gas pumps offer a wide range of capacities, pressures, and drives. Technical-rating data are presented along with detailed design and construction data. The pumps utilize the rotary positive-displacement principle that assures a constant volume of gas with each revolution. **Write or call: Roots-Connersville Blower, 900 West Mount Street, Connersville, Ind., for Bulletin XA-458.**

Header for well-fracturing

. . . treatment is designed to permit visual inspection of all parts. It's described in a new technical data sheet. The erosion of metal has been minimized by the use of larger fluid passages and by the use of steel of greater thicknesses, strength, and proper hardness. Machined union connections are used in the threaded and welded nipples. Check valves are built into the header to prevent back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No matter how shallow or deep the well, you can count on the dependability of Republic products throughout every joint in your string.
Republic has tripled Casing and Tubing production in the last ten years. Seamless and welded. Field stocks strategically located. Specify "Republic".
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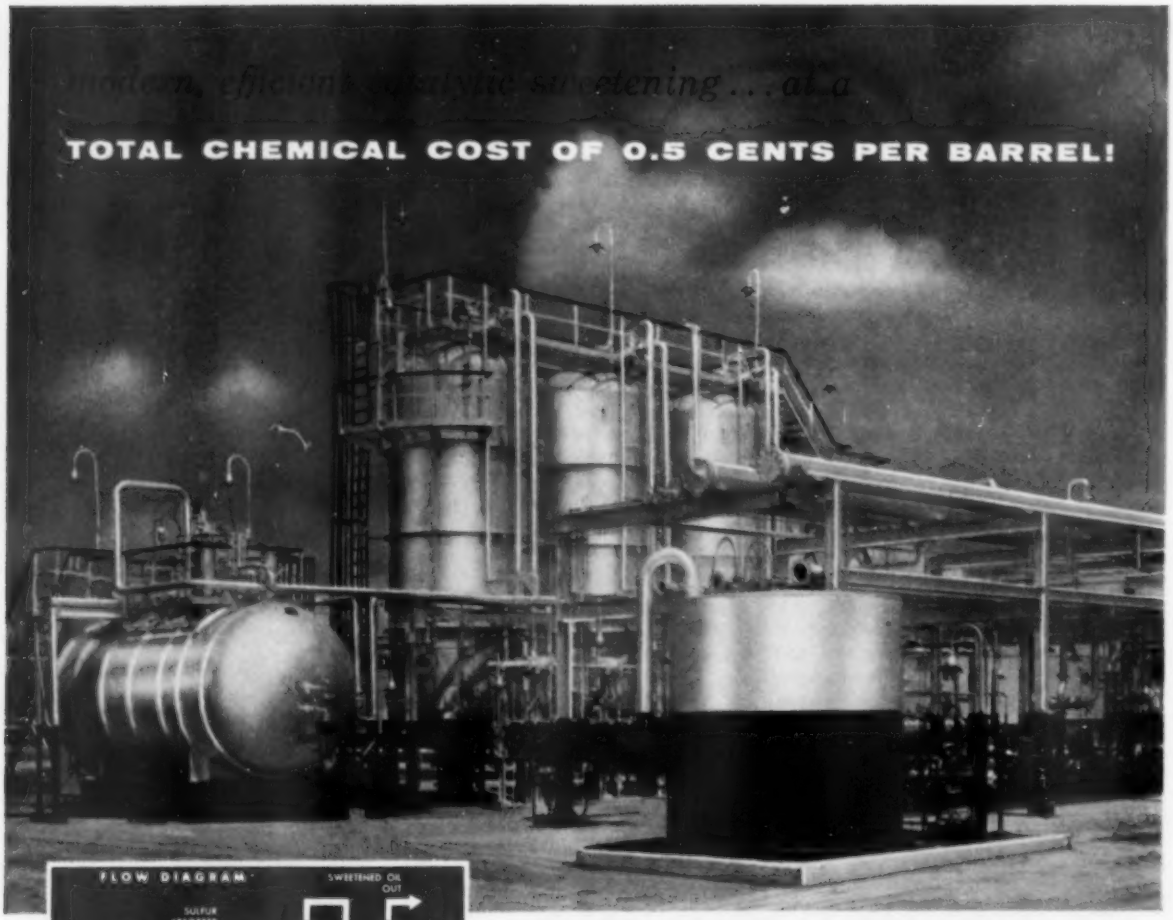

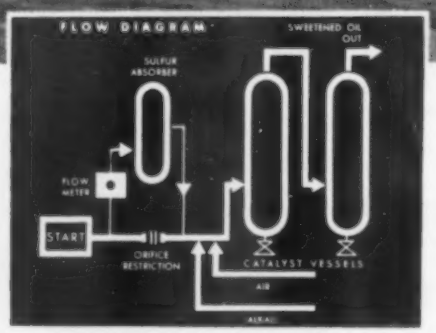

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Controlled quantities of sulfur, alkali and air are added to the product stream. The resulting mixture is passed through a catalyst bed. The process sweetens by converting mercaptans to disulfides by oxidation—in an automatic, continuous operation.

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It's true. The effective sweetening of distillates in the gasoline, kerosine, burning oil range can be accomplished the Petreco Bender way for about half a cent a barrel—for all chemical costs, including catalyst maintenance. (Installation cost also is low, ranging from $10 to $20 per barrel/day of throughput.)

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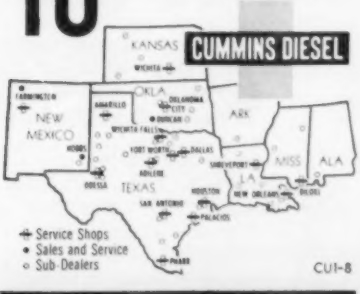

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flow if treating lines fail. **Write or call: Dowell division of The Dow Chemical Co., P.O. Box 536, Tulsa 1, for Frac Header bulletin.**

New Standard Oil Toledo refinery

. . . is the subject of a new 20-page brochure. The brochure is divided into eight sections, each describing a different facet of the 60,000-bbl. per stream-day plant. Sections are devoted to the planning schedule; integrated design; plant layout; dual gas-recovery system; gasoline-blending facilities; the scale-models used in designing the plant; control system; and the reforming section. **Write or call: M. W. Kellogg Co., 711 Third Avenue, New York 17, for Sohio Kellogram.**

Multiple-seal gate valve

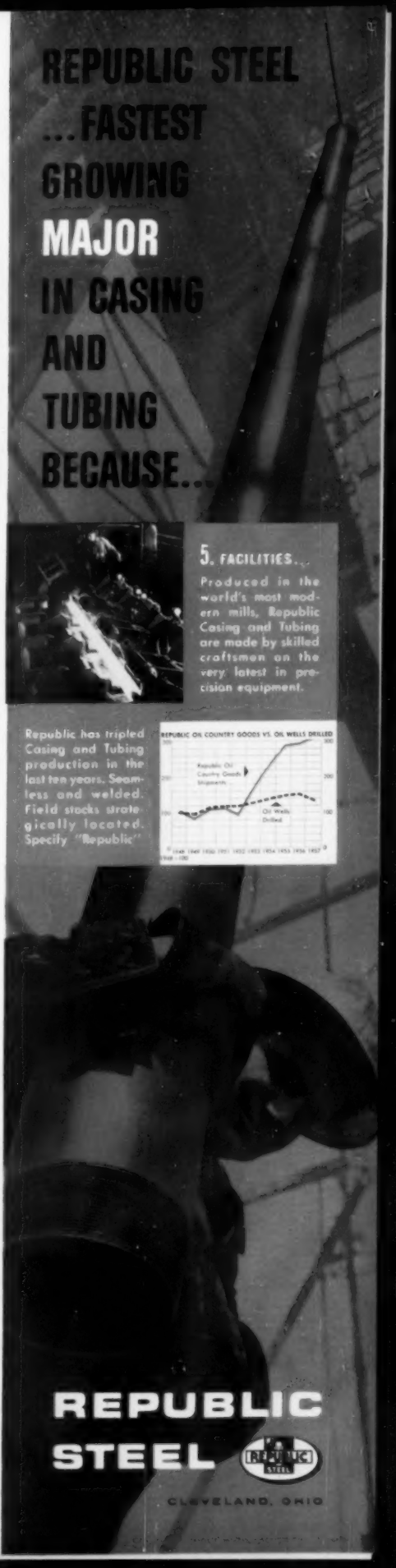
. . . is a new leakproof type for aromatics, hydrocarbons, and LPG that's described in new four-page Bulletin GV-30. The valve features two metal-to-metal seats and two secondary O-ring seals. Dimensions and engineering data are included as well as examples of illustrations. Included is a diagram that shows how to change O-rings. **Write or call: Vernon Tool Co., Ltd., 1101 Meridian Avenue., Alhambra, Calif., for Bulletin GV-30.**

Basic switch Catalog 62c

. . . features significant innovations in basic switches for industrial and commercial applications. New switches covered in the 32-page catalog are the high-precision roller-lever switch, adjustable actuator switch, and pulse switch. Coin switches are also included as well as new mounting brackets and auxiliary actuators for basic switches. The catalog gives details of over 200 catalog listings of basic switches and related devices. **Write or call: Micro Switch Div., Minneapolis-Honeywell Regulator Co., Freeport, Ill., for Catalog 62c.**

Glass-fiber safety ladder

. . . that's said to be nonconducting, nonabsorbent, lightweight, and strong, is described in a new technical data sheet. The Type FSL straight-safety ladder has high-tensile-strength aluminum rungs. This combination makes it safe for use around high voltage and chemicals, the maker says. It takes a minimum of 75,000 volts to flash an arc between alternating rungs. **Write or call: Aluminum Ladder Co., Worthington, Pa., for Safety Ladder bulletin.**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IN CASING
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Produced in the world's most modern mills, Republic Casing and Tubing are made by skilled craftsmen on the very latest in precision equipment.
Republic has tripled Casing and Tubing production in the last ten years. Seamless and welded. Field stocks strategically located. Specify "Republic"
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EQUIPMENT MEN ..... IN THE NEWS

English firm now building

. . . Ideco, Inc., mud pumps. Pulsometer Engineering Co., Ltd., is building Ideco mud pumps under a license agreement concluded with Dresser Limited, C. A., a subsidiary of Dresser Industries, Inc. G. W. Walton, president of Ideco, stated that this new agreement would complement the manufacturing facilities of another English licensee, Woodfield Rochester, Ltd.

Globe Oil Tools Co. elects

. . . J. V. Pennington as president, succeeding Mrs. C. E. Whittaker. Mrs. Whittaker will continue as chairman

J. V. Pennington

C. R. Whittaker

of the board. Other officers are: C. R. Whittaker, vice president; L. I. Wardle, vice president, sales; A. E. Drennen, secretary; and F. C. Weigel, treasurer. Pennington formerly was with Reed Roller Bit Co.

Oakite Products, Inc., names

. . . Eustace Lingle as vice president in charge of industrial sales and education. He joined Oakite in 1929. In his new position, he has been given additional responsibilities in sales, sales planning, and technical education.

Security Engineering Division demonstrates quality control

. . . as Mark Gardner, vice president of Delta Drilling Co., Tyler, Tex., and members of his staff examine a roller bearing inspection machine used in the manufacture of rock bits during a recent tour of Security Engineering's Dallas plant. Shown are Dresser Industries executive vice president James P. Gasser; George Stetson of Delta; Gardner; Security chief inspector Lynn Malley; Clyde Johnson of Perforaciones Delta, C.A.; and C. L. Griffin, Security sales manager for United States and Canada.

Johnson, vice president of Perforaciones Delta, C. A., is permanently located in Caracas, Ven. The South American company has 21 rigs in all active areas in Venezuela and also has district offices in Maracaibo and Pariaguan, Ven. Stetson is located in New Orleans and is chief engineer of Delta, one of the largest drilling firms in the country.

The bearing machine shown above was built by RCA and features electronic devices capable of measuring bearing diameters in two separate places to within 50 millionths of an inch simultaneously. It is one of the few such machines in commercial use today performing this two-point measurement. Uniformity of size of these bearings is most critical. Under operating conditions loads could be concentrated on a single oversized bearing causing progressive damage.

George H. Werner appointed

. . . advertising manager for "Lightnin" mixers, according to James V. Donohoe, vice president and director of sales for Mixing Equipment Co., Rochester, N. Y. Before joining Mixco, Werner was advertising manager at Yawman & Erbe Manufacturing Co.

K. L. Byerly, Jr., promoted

K. L. Byerly, Jr.

. . . from general sales manager to vice president and general manager of Magcobar de Venezuela, C. A., reports W. W. McBrien, vice president and director and vice president, foreign operations of Magnet Cove Barium Corp. Byerly succeeds Ten Eyck Hull. Byerly has served as assistant to the president of Magcobar and before joining the company was with Cities Service Oil Co.

Los Angeles Nomads induct new members

. . . at its regular meeting in September. Pictured are: Max D. Martin, regular, of H. C. Smith Oil Tool Co.; Russell W. Johnson, associate, of Kraloy Plastic Pipe Co.; N. Gordon Clarke, associate, of Hughes Tool Co.; Ole Olson, ritual master, of Southwest Engineering Co.; and Walter Ennis, his assistant, of Walter Ennis Co.

Alco Products, Inc., installs

. . . at its Beaumont, Tex., plant an electronic computer for rating heat exchangers. The unit is an LPG-30 manufactured by Royal McBee Corp. This new data processing machine rates heat exchanger products; that is, it automatically selects the proper heat exchanger to perform a given duty. This is the second computer to be used by Alco for rating heat exchangers. An IBM type 650 electronic

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CORE BOXES

Corrugated boxes for storing Empire Sand Sample Envelopes manufactured to fit your specifications. Inquiries for any size and quantity solicited.

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data processing machine has been in use at the Dunkirk, N. Y., plant for some time.

Robert G. Allen elected

R. G. Allen

. . . to the board of directors and the executive committee of Bucyrus-Erie Co., according to W. L. Litle, president and chairman of the board. Allen is executive vice president in charge of all manufacturing and sales. He joined the company in July 1957 as a vice president. Before coming to Bucyrus-Erie, he had been with Walworth Co., Duff-Norton Mfg. Co., and the Pesco Products and Wooster divisions of Borg-Warner Corp.

Whitson Engineering Co. named

. . . as a master distributor by U. S. Guage Division of American Machine & Metals, Inc. Whitson Engineering specializes in sales of instruments, controls, and allied engineered products. Head of the newly formed company is Leo E. Whitson.

Union Tank Division opens

F. C. McDaniel

. . . a branch office and warehouse in Farmington, N. M., according to Walter G. Johnson, general manager. Frederick C. McDaniel has been named manager of the new branch. The Farmington office and warehouse are in a 40 by 80-ft. building. A complete line of Union equipment will be stocked at the new sales and service center.

Grove Valve hosts

. . . the recently graduated class of the API School of Pipeline Technology on a visit to inspect the Oakland, Calif., plant of Grove Valve & Regulator Co. Hosting the group during the session was M. H. Grove, president. The group met with the engineering and research heads to discuss the latest advances in pipeline valving.

Development study announced

. . . between Standard Oil Co., Ohio, and The Thompson-Ramo-Wooldridge Products Co. concerning the application of digital computers to automatic process control. E. N. Marsh, chief of Sohio's process engineering division, stated that the purpose of the

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Republic is completely integrated—a big advantage in producing quality Casing and Tubing. Integration of resources has helped to make Republic the fastest-growing "major" in Casing and Tubing.

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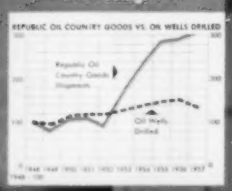

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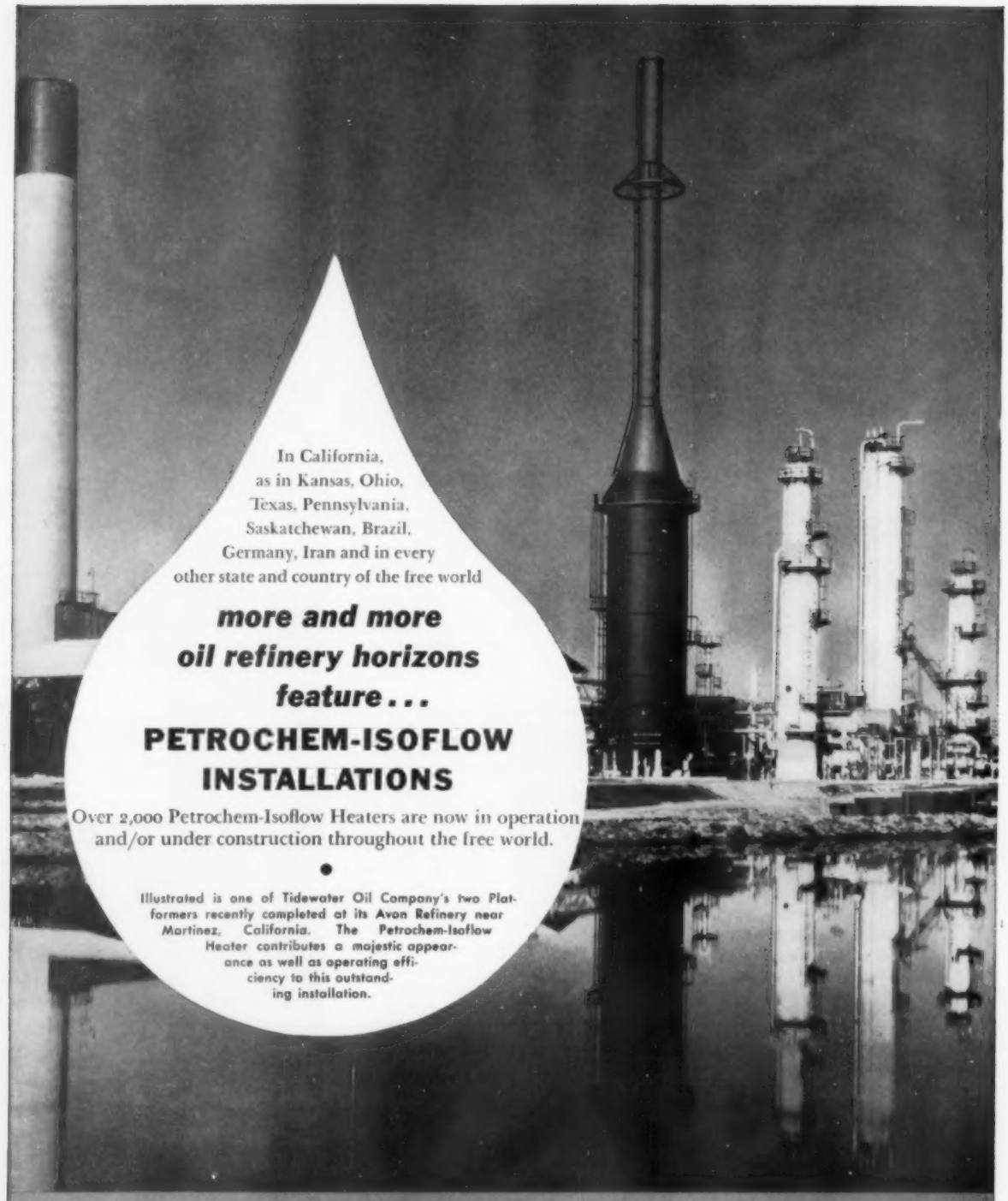

In California,
as in Kansas, Ohio,
Texas, Pennsylvania,
Saskatchewan, Brazil,
Germany, Iran and in every
other state and country of the free world

more and more
oil refinery horizons
feature . . .

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INSTALLATIONS

Over 2,000 Petrochem-Isoflow Heaters are now in operation and/or under construction throughout the free world.

●

Illustrated is one of Tidewater Oil Company's two Platformers recently completed at its Avon Refinery near Martinez, California. The Petrochem-Isoflow Heater contributes a majestic appearance as well as operating efficiency to this outstanding installation.

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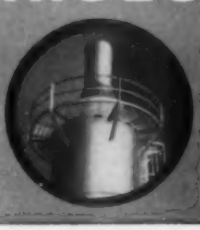

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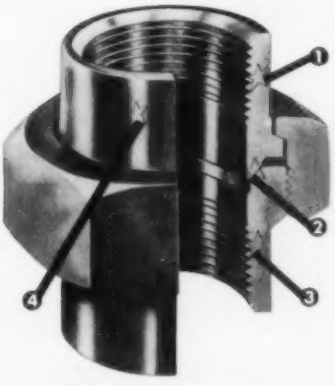
gives you all these features for your forged steel pipe union requirements



1. **Uniform walls** for even expansion and contraction under temperature changes. They follow the pipe!

2. **Catawissa Ball-to-Angle Seats** give you a "Perfect Seal" regardless of pipe alignment!

3. **More than adequate** wall thicknesses give you Catawissa's 3-to-1 Safety Factor (3000-lb. service, 9000-lb. test; 6000-lb. service, 18000-lb. test)!

4. **Round, straight barrels** for fast wrenching. No uneven or tapered surfaces to cause wrench slips or wrench locking!

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Write for Catalog 58 showing the complete Catawissa line of Perfect Seal Products.

for complete, guaranteed satisfaction

. . . always specify
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study is to explore new automation frontiers for the control of Sohio's refinery units. This joint study will be based on the newly-developed "systems engineering" approach to process optimization.

Johnston Testers, Inc., forms

. . . a marketing division to handle sales and service of the new sonic pump, according to D. C. McCann, president. C. F. Riker heads the new division as general manager. He was formerly a sales engineer. Sales manager for the division is Jack Schuelke, until recently technical editor for World Oil. District sales engineer with headquarters in Houston is W. E. Hill. Sonic pump installation engineer for the organization will be Jim Hamilton.

C. F. Riker

Jack Schuelke

W. E. Hill

Jim Hamilton

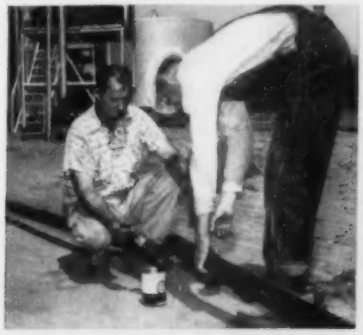
Homco announces changes

G. D. Bird transfers from Odessa, Tex., to Farmington, N. M. Bernard Killman shifts from Houston to Harvey, La. H. D. Le Blanc moves from Lake Charles, La., to Houma, La. T. J. Lee, Houston, goes from district manager to sales and service representative. H. B. Meredith transfers from Morgan City, La., to Houma. L. R. Overstreet changes from Farmington to Sullivan City, Tex. M. B. Watson moves from Carrizo Springs to Pearsall, Tex.

New Houston firm formed

The organization, Walker Constructors, Inc., a subsidiary of Walker & Associates, Inc., consulting engineers, will specialize in refinery, petrochemical, and pipeline construction and maintenance. Vice president and general manager is J. L. Bates, former chief engineer, Texas Butadiene & Chemical Corp. plant in Channelview, Tex. J. G. Huff, former

REPUBLIC STEEL... SERVES ALL SEGMENTS OF THE OIL INDUSTRY



REPUBLIC SRK PLASTIC PIPE eliminates corrosion problems in many oil and gas handling applications. Lightweight, easy to cut and join, it goes in fast, makes a permanent installation above or below ground. Available in a full range of sizes. Send coupon.

PREFABRICATED STEEL BUILDINGS, manufactured by Republic's Truscon Division, are the quick, economical solution to oil country storage and shelter problems. Thirty-two to 48 feet wide. Any desired length. Three-week delivery to your site. Send coupon.

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construction manager, Grebe & Doremus Process Co., is the general superintendent.

South American office opened

... by the international division of Graver Tank & Manufacturing Co., Inc., in Caracas, Ven., reports W. C. Root, president. William I. Woodson has been named general manager of Venezuelan operations. Edwin C. Barnes, field engineer, was named as Woodson's assistant. Woodson formerly served as manager of the Venezuelan division of Texas Petroleum Co. and in Turkey as petroleum advisor to the Turkish government.

This seismic recording truck to be used on Dhofar Province

... by General Geophysical Co. Dhofar Province is situated on the extreme southern end of the Arabian Peninsula. This geophysical unit was shipped in September from the Port of Houston. General's party manager for this venture is Ruben A. Braziel. His observer is Don Trace. Party chief is W. L. Tomlin. Pictured with the unit are Trace and Braziel.

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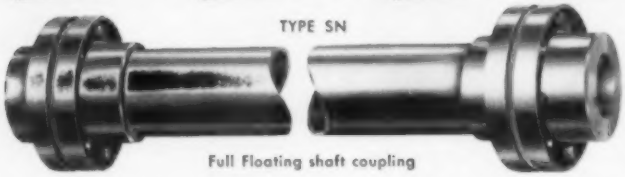

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Thomas Couplings are used to advantage on Pumps, Compressors, Cooling Towers, Rigs or any other tough job where continuous operation and dependability are required.

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5 Original Balance for Life
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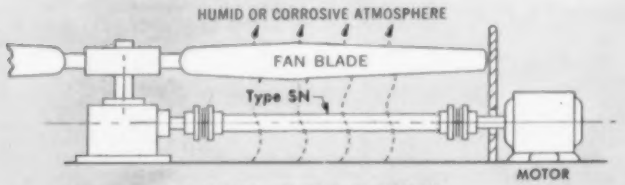

COOLING TOWER INSTALLATION

In the typical cooling tower installation shown above, the motor — outside the humid or corrosive atmosphere — is connected by a floating-shaft coupling to the gear box under the large slow-speed, horizontal-blade fan.

Write for engineering catalog 51A, and the name of your nearest Thomas representative

THOMAS FLEXIBLE COUPLING COMPANY

WARREN, PENNSYLVANIA, U.S.A.

George A. Green appointed

G. A. Green

... eastern regional manager for all process instruments sales of the scientific and process instruments division, Beckman Instruments, Inc., reports R. F. Brown, field sales and service manager. Green will be located at the office in Mountainside N. J., headquarters for all sales operations in the eastern United States.

Texas Instruments awards

... a contract for constructing a 78,500 sq. ft. building to house the Central research laboratory to Robert E. McKee General Contractor, Inc., according to Texas Instruments, Inc., President P. E. Haggerty. The building will be the second in a group to be erected on TI's 300-acre site in Dallas. Completion is planned for early 1959.

J. C. Richards, Jr., named

J. C. Richards, Jr.

... as vice president, sales, of B. F. Goodrich Industrial Products Co., according to C. O. DeLong, president of the division of The B. F. Goodrich Co. Richards joined B. F. Goodrich in 1934. In his new capacity he succeeds R. V. Yohe, elected president and chief executive officer of B. F. Goodrich Canada.

Duff-Norton Co. promotes

... Edward H. Hodgson to sales manager, worm gear jack division, and appoints Howard E. Flood as man-

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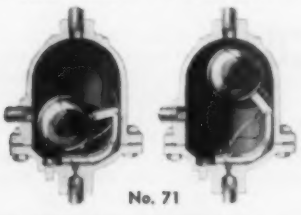

No. 71

Spring holds valve tight until float buoyancy overcomes spring pressure. Then spring snaps up, opening valve wide. Before all water leaves trap, valve snaps closed.

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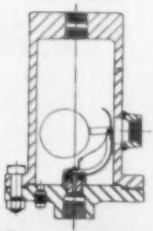

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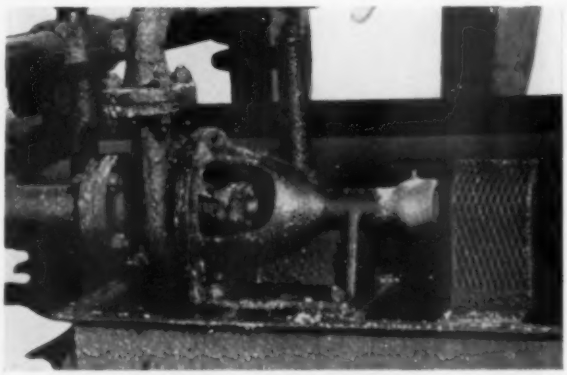

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WEST COAST PLANT: BURBANK, CALIFORNIA
SOUTHWEST PLANT: GARLAND (DALLAS COUNTY), TEXAS

ager, sales promotion and marketing. Hodgson will direct sales of the company's line of worm gear jacks. Flood will be in charge of all activities relating to sales promotion, marketing, advertising, and public relations.

Crum and Scherer appointed

N. R. Crum

. . . to the sales organization of Lunkenheimer Co., according to M. W. Pauly, vice president in charge of sales. N. R. Crum becomes manager of the Los Angeles office. J. Paul Scherer has been appointed a sales representative and assigned to the New York City office.

M. J. McCaughey named

M. J. McCaughey

. . . general sales manager of Tuthill Pump Co., according to J. G. Tuthill, president. McCaughey first joined Tuthill in 1954 as a sales engineer. He previously served with Parker Appliance Co. In his new assignment, he will direct sales of all Tuthill's products.

E. E. Storey joins

E. E. Storey

. . . Jones & Laughlin Supply Division at Tulsa as supervisor, tank sales, according to W. L. Wolfe, vice president, sales. Storey entered the petroleum industry as a salesman in 1936. He has been with Unit Rig Co.; Erie Pump Co.; Black, Sivalls & Bryson Tank Co.; and Maloney-Crawford Tank & Manufacturing Co. He joined Continental Tank Co. in 1951 and remained with Continental until his current transfer to J&L.

Canadian company formed

. . . to manufacture and distribute Tapecoat protective coal tar coatings in tape form, according to A. W. Bohne, general partner of The Tapecoat Co. of Evanston, Ill. Known as Tapecoat Co. of Canada, Ltd., the new corporation has its offices and manufacturing facilities in a new 5,000-sq. ft. plant at Rexdale, Ont. J. Russell Wall will serve as the president of the Canadian firm. He joined Tapecoat in 1952.

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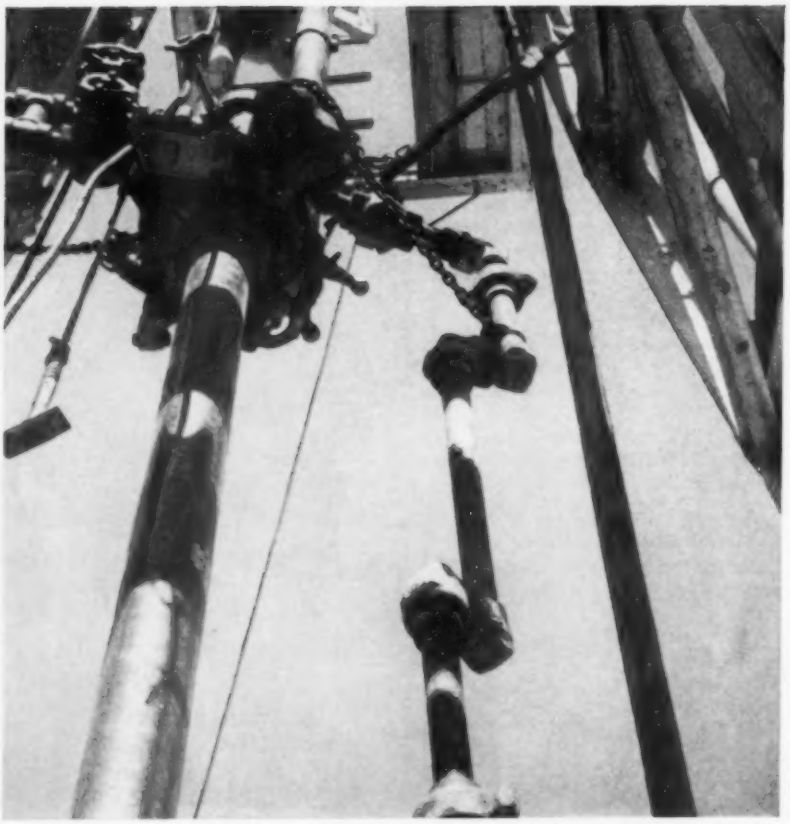

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It's Deeper Than You Think!

ALL EYES are on West Texas these days as Phillips Petroleum Co. 1-EE University (A on map) aims its bit at target depth 25,500 ft. The historic wildcat, after finding the Ellenburger objective at a record 24,974 ft. depth, will probe the formation at least 526 ft. in order to see what's there. So far, the well has shown little promise of production, but the operator is hoping for a productive Ellenburger section.

Sparse drilling . . . The Ellenburger top at the 1-EE is an eye-opener for geologists. Theory has always held that to reach the formation in the center of the vast Delaware basin would require at least a 25,000-ft. hole. That theory may now have been exploded.

Actually, not enough is known of the pre-Permian section in the Delaware to reach a conclusion; the basin is still sparsely drilled to that section. But the finding of the Ellenburger at 24,974 ft. in the Sheffield channel, believed to be an ancient seaway connecting the Delaware and Midland-Val Verde basins, would indicate a much greater depth for the Delaware than has previously been believed. The Phillips 1-EE lies in the deepest part of the channel, where it abuts the Central Basin platform. Within the basin itself in western Winkler and Ward counties, and in eastern Reeves and western Pecos counties, it may well be that we'll find the Ellenburger buried beneath 30,000 ft. or more of overburden.

Phillips is frankly "looking for another Puckett" at its three deep wildcats in Pecos County. Puckett is a major gas-condensate field with Devonian pay at 10,400 ft. and Ellenburger pay (1,500 ft. of it) at 14,000-15,000 ft. At its 1-A Harral (B on map), no Ellenburger was found to total depth 19,020 ft. At the 1-A Montgomery (C on map), the formation was topped at 22,598 ft. and the well is now bottomed at 23,400 ft. Pan American Petroleum Corp. 1-CS University (D on map) went to 21,687 ft. before abandonment in 1957, where it was still in Mississippian rocks.

And another Puckett . . . This deep search represents a new turn in West Texas exploration effort. Wildcatters now are convinced that some elephant fields (i.e. "more Pucketts") lie in the depths of the Delaware and Val Verde basins and in the Sheffield channel. The successes at Brown-Bassett field in northeastern Terrell County (E on map) bear out the conviction. Here, a 70-section structure is shaping up, and only 3 producers are on the books. Production comes from Silurian and Ellenburger at 12,400 ft. and 14,000 ft. respectively, and another Puckett is in the making.

Within the Delaware basin proper, not enough deep wildcatting has been done to really paint the picture. Recent deep failures there include the ill-famed thrice-abandoned Gulf Oil Corp. 1 Northrup "A," (F on map), which never found the Ellenburger to total depth 18,771 ft., and Standard Oil Co. of Texas 1 Balmorhea Ranches (L on map), a very high well on the basin's southern rim. The latter well found the Ellenburger at 9,800 ft. and bottomed in preCambrian at 11,312 ft. last year.

Encourage a deep campaign . . . But failures have not discouraged Delaware wildcatters. New deep tests are commenced regularly. At the moment, these ultradeep contracts are on the way down:

WEST TEXAS WILDCATTERS are busily probing the depths of the Delaware basin, the Sheffield channel, and the western Val Verde basin in a search for new deep gas reserves. All the wildcats lettered on this map have contract depths in excess of 12,000 ft.

BY FRANK J. GARDNER

Reeves County, Texas: T. X. L. Corp. 1 Reeves-State, target 15,000 ft.—G on map; and Gulf 1 Todd, target 13,200 ft.—O on map.

Pecos County, Texas: Hunt Oil Co. 52 Elsinore Royalty Co., target 14,000 ft.—H on map; and 53 Elsinore Royalty Co., target 15,000 ft.—H on map.

Terrell County, Texas: Gulf 1 Prosser, target 15,200 ft.—I on map; Texas Pacific Coal & Oil Co. 1-A Dunlap, target 12,000 ft.—J on map; Great Western Drilling Co. 1 Chapman Ranch, target 15,000 ft.—K on map.

In the northern reaches of the Delaware, other interesting discoveries are being made in sands of Pennsylvanian age. The play at M on the map was set off by the recent completion of Union Oil Co. of California 1-26 Crawford in southeastern Eddy County, New Mexico. This one was a Morrow gas strike at 11,060-11,471 ft. At N, is Shell Oil Co. 1 James Ranch, another recent gas discovery in Permo-Pennsylvanian sand at 10,824-10,917 ft.

So keep your eyes on the Delaware basin, the Sheffield channel, and the Val Verde basin. Here are three new theaters of deep discovery. Shallow campaigns aimed at the Delaware sand are paying off handsomely, but the deep campaign is expected to outstrip anything since the heyday of the Midland basin.

An examination of this California area shows . . .

A 50-year-old prediction holds water

BY RALPH ARNOLD
Santa Barbara, Calif.

EARLY IN AUGUST 1907, the writer said that, in his opinion, there would never be a commercially important oil field on the West Coast of the United States north of Coalinga nor south of the Santa Ana River, California.

He's sorry to say the prediction has held good for over half a century with two exceptions, San Ardo field, Monterey County, and Raisin City field, Fresno County. What was the basis for such a broad and economically important statement and the circumstances under which it was first made?

In the late summer of 1907, Secretary of the Interior James R. Garfield, of President Theodore Roosevelt's cabinet, came to California to look into the oil situation. While the Secretary was in Los Angeles the writer, who was then in charge of the oil investigations of the United States Geological Survey on the Pacific Coast, was called into a conference regarding the oil reserves.

The Panama Canal had not yet been completed and the President was anxious about a West Coast source of supply of oil fuel for our navy. The statement in the first paragraph of this article was in answer to a direct question by the Secretary as to the oil reserves of the West Coast.

The foundation for this answer was largely the knowledge that the writer and his associates had personally secured in the field. He had made a reconnaissance of the Tertiary in the coal fields of Eastern Washington in 1900, and of parts of Puget Sound and the coast of the Olympic Peninsula and other Tertiary localities in Washington in 1904. He had done detailed mapping of the Santa Cruz Mountains, California; he had visited most of the spots or small local areas where oil in small amounts had been discovered from one end of California to the other.

Finally, he and his associates had either mapped or made reconnaissance surveys of all of the then-known commercial oil fields in the San Joaquin Valley, Santa Maria, Ventura and Los Angeles basins. It was believed that the productive oil limits of California had been pretty well outlined in the first 10-year period of

Author is consulting petroleum geologist and engineer, Santa Barbara, Calif.

intensive development, 1897 to 1907.

The things that influenced the writer most in reaching these conclusions were:

- His belief that the important deposits of oil were derived from organic remains, mostly diatoms, supplemented by other marine micro-organisms, and, possibly fish.
- All of the important oil deposits were associated with the Tertiary formations. The Cretaceous and Jurassic, with other exceptions, carried little oil, while the still older formations yielded no oil at all.
- All of the important fields occurred in four major basins—upper San Joaquin Valley, Santa Maria, Ventura and Los Angeles. The minor pools or occurrences were in small basins such as in Humboldt, Contra Costa, San Mateo, Santa Clara, Monterey and San Luis Obispo counties.
- The diatomaceous deposits faded out north from the Coalinga and Santa Maria areas and so did the highly organic marine shales of the Eocene. Southeast of Santa Ana River the diatomaceous shales were rapidly replaced by sandstones intercollated with the diatom zones; and the Eocene, though present, did not carry the richly organic shales of the Eocene oil-forming and producing areas of the San Joaquin and Ventura basins.
- The Tertiary areas long the Pacific Coast of northern California, Oregon and Washington, offered no significant evidences of oil or organic strata to the writer's knowledge. He did find a seepage and other signs of high-grade oil in serpentine and conglomerate near Point of the Arches, 11 miles south of Cape Flattery, in 1904 but the occurrences were local in extent.[1]

Millions of dollars have been spent in trying to enlarge our productive limits on the West Coast, with only slight success. It is hoped, however, that further drilling with improved methods will disclose new oil deposits of importance outside the limits so far proven.

In the writer's opinion there are many local areas or pools, and possibly a few which might rate as fields, still remaining undiscovered in the territory between Coalinga and Santa Ana River. Drilling to greater depths and testing of fringe areas in some of the old fields offer good opportunities for success.

The map accompanying this paper shows the distribution of all of the commercially important oil fields of the West Coast of the United States as of 1957.

1. Bull. Geol. Soc. Am. vol. 17, pp. 459-460, 1906.

Another Oklahoma dry county may fall into producing column

A MANNSVILLE AREA wildcat in southern Oklahoma may open first oil production in Johnston County. The indicated discovery is Sunray-Mid-Continent Oil Co. 1 Rawson in NW NE SW 28-4s-4e.

A test at 8,266-8,325 ft. got 40 ft. of 38.7°-gravity oil and 100 ft. of oil and gas-cut mud from the basal McLish sand of Ordovician age. Nearest production is 2½ miles southeast at Southeast Mannsville field, a Marshall County area.

Sunray's possible strike is on the northwest end of the Madill-Aylesworth-Mannsville trend of faulting in the southeastern portion of the Ardmore-Marietta basin. The only production in Johnston County is in the far northeast corner near Bromide at North Wapanucka, a gas field of the McAlester basin.

Discoveries dot Illinois basin

ILLINOIS basin exploration last week included discoveries in Clinton and Wayne counties, Illinois, Gibson and Spencer counties in Indiana, and Henderson County in western Kentucky.

... Illinois. Brand Oil Co. 1 Weiberg Brothers, SW SE SW 9-1n-5w, Clinton County, recovered 450 ft. of gas, 230 ft. clean oil, 180 ft. oil-mixed mud on drill-stem test of the Silurian at 1,966-75 and 1,988-2,006 ft. This indicated strike, now waiting for cable tools, is 2 miles east of New Baden.

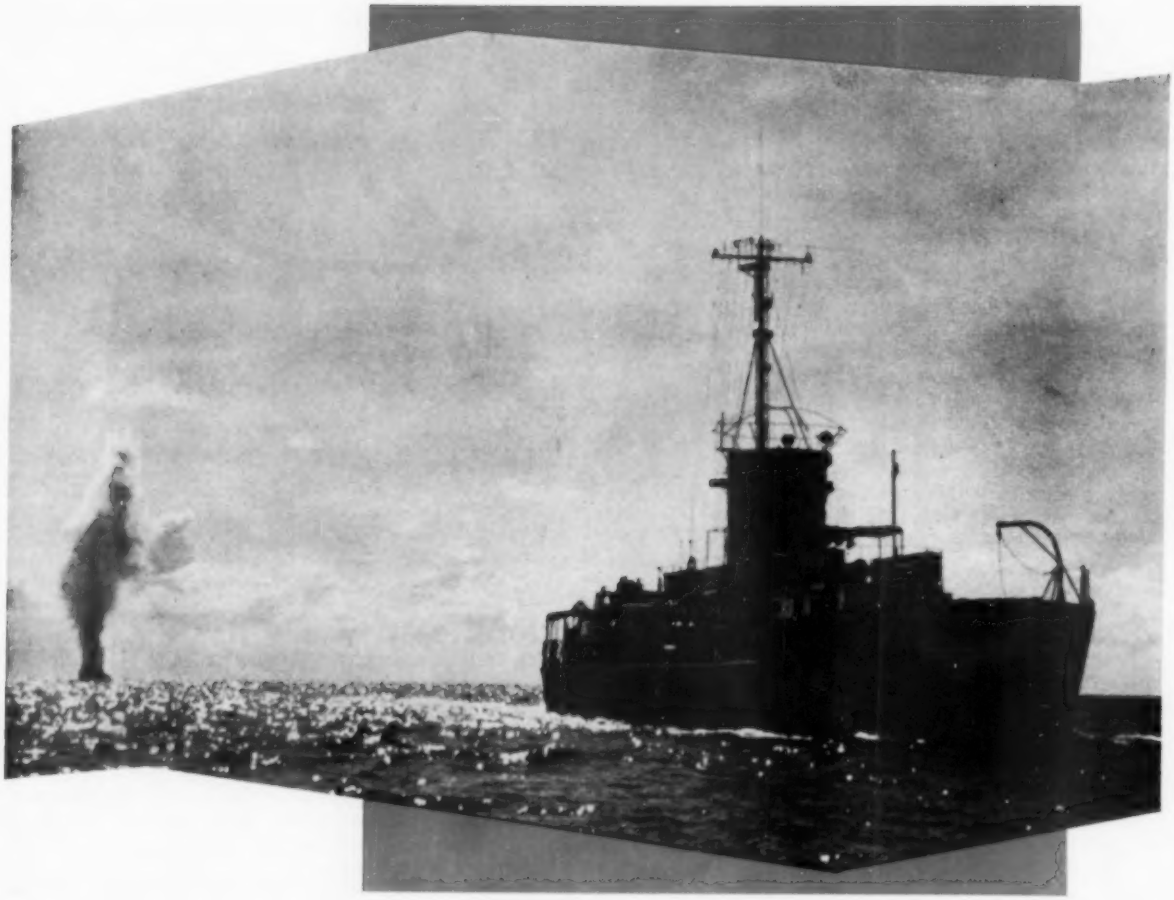
Wayne County's news consisted of an oil discovery at Farrar Drilling and Wausau Petroleum Co. 1 Heidinger in NW NE NW 20-1s-9e, and success at a Kingwood Oil Co. wildcat, the 1 S. E. Talbert in SW NW SE 32-1n-6e.

The Heidinger discovery was completed for 198 bbl. of oil per day from McClosky at 3,286-90 ft. This one is 7 miles northeast of Fairfield. The Talbert discovery is on pump for Aux Vases tests at 3,123-48 ft. It swabbed 16 bbl. of oil in 4½ hours. Location is 3 miles south of Johnsonville.

... Indiana. Arthur J. Fritz 1 Charles G. Kruse, NE SE NE 2-3s-10w, Gibson County wildcat, is testing O'Hara lime at 1,990-2,001 ft. The well swabbed 20 bbl. per hour, natural. This is the second well in a new producing area south of Princeton.

In Spencer County, 2 miles east of Santa Claus, NE NE NE 8-5s-4w, Clay Herrell and Cox Drilling Co. got 30 bbl. of oil daily from the Jackson sand at 630-57 ft. at the 1 Anna Collingnon.

... Kentucky. Wausau Petroleum Co. and Ashland Oil & Refining Co. 1 C. M. Schuster, 15-O-24, Henderson County wildcat, is a new ¾-mile Aux Vases extension discovery near Cherry Hill Church, 2 miles northwest of Robards.



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Twin hits shrink "No Man's Land"

TWO widely spaced wildcat oil discoveries push Louisiana's producing areas farther into the state's sparsely developed mid-section. Indicated are Shell Oil Co.'s Saratoga discovery in Sabine Parish, and A. J. Hodges' Wilcox strike in Rapides Parish.

DISCOVERY of two new oil fields in 1 week breaks the relative quiet that has prevailed through Louisiana's sparsely developed midrift parishes.

The new fields are more than 70 miles apart, one in Sabine Parish, on the state's western border, and the other in Rapides Parish, near the state's center. The latter is its parish's second discovery this year, one having preceded it last February.

In Sabine Parish, Shell Oil Co. completed a significant oil well, its first on its Pendleton area prospect, about 9 miles southwest of Many, county seat. It is about the same distance south of that county's Zwolle field, nearest production.

On the western side of the state, it is the fartherest south of any North Louisiana field. The most northerly South Louisiana field, in Beauregard Parish, is more than 50 miles south, across a meagerly explored expanse.

The well, 1 Long Leaf Lumber Co., flowed at the rate of 132 bbl. of 41°-gravity oil per day in a test through ¼ in. choke. Flowing pressure was 100 psi., and gas-oil ratio 450 cu. ft. per barrel.

Production is from the Saratoga chalk, uppermost member of the Upper Cretaceous-Taylor group. Pay is perforated at 2,840-2,900 ft. with hole plugged back to 2,935 ft. from a drilled depth of 7,978 ft. Saratoga is one of several productive formations in Zwolle field.

The Rapides discovery is by A. J. Hodges and others, of Shreveport, at their 1 Nesbitt. It is in the extreme north corner of the parish, 5½ miles northeast of Holloway, and near the LaSalle parish line. It is 4½ miles south of Nebo, nearest production, in the latter parish.

Tested through ¼-in. choke, it flowed an estimated 200 bbl. of 43°-gravity oil per day with pressure of 100 psi. and gas-oil ratio of 150 cu. ft. per barrel. Its production is from Wilcox sand, perforated at 4,095-97 ft., in hole drilled to 5,565 ft.

Drilling already is under way on a south offset as the first confirmation attempt by the same operators. The second test is on Hodges' Lee Lumber Co. lease.

Location of the new field is about 15 miles northeast of the parish's new Kolin field, discovered last February by Roger J. Bassett with oil production from a 6,400-ft. Wilcox sand. It is about 6 miles north of production in the parish's Big Island area.

Outlook extends pre-Madison pay in Montana

A GOOD EXTENSION discovery to Montana's Outlook field in Sheridan County was reported last week.

Amerada Petroleum Corp., discoverer of this important pre-Madison field, got 80 bbl. of oil per hour from Outlook-Silurian pay at 9,093-9,116 ft. The well is the 3 Ruegsegger in NW NE NW 19-36n-53e. The company made location for an east offset at 4 Ruegsegger in C NE NE 19-36n-53e.

Outlook field is in northeastern Montana's portion of the Williston basin. Production is from Silurian, Devonian, and Ordovician—the main pay being the Outlook or Silurian. The field's discovery was considered one of the exploratory highlights of the Williston basin's oil history when it was opened about 3 years ago.

Its opening paved the way for a brisk pre-Madison Mississippian search throughout the basin, particularly in the Beaver Lodge area of North Dakota, in Divide County, northwestern North Dakota, and in northeastern Montana. Most basin production is from the Mississippian.

Discovery prospect reported in Wyoming's Carbon County

REMOTE Morrison-Jurassic gas production is reported at Mobil Producing Co.'s F-14-4-G Unit in SW SW SW 4-21n-79w, Carbon County, Wyoming.

The well flowed 3,250 M.c.f.d. of gas on drill-stem test of the basal Morrison at 10,793-10,896 ft. Pipe recovery included 130 ft. of condensate.

This new discovery prospect is located on the 4,705-acre Carbon Unit where working interests are held by British-American Oil Producing Co. and Sun Oil Co. Geologic location is in the merging area of the Hanna and Laramie basins.

Medicine Bow field, 4 miles southeast, is a Tensleep-Pennsylvanian. There is also Tensleep production at East Allen Lake field, 6½ miles northeast.

Exploration Outlook

...appraising the future by surveying the past

A YEAR of top exploratory achievements came to a climax in September with Canada and the Four Corners harvesting the biggest crop of newsmakers.

Alberta's famed Berland River wildcat broke nearly every drilling record in western Canada . . . and this Shell and British American strike even broke a world's production record.

It is rated the world's biggest single gas well at 1.5 billion cubic feet per day calculated open flow.

Western Canada's deepest production was found in the Devonian D3 reef at 12,014-12,235 ft. It's the thickest productive reef ever tapped in Canada.

Berland River climaxes a brisk gas campaign in the Canadian Rockies Foothills belt . . . a search that has outstripped any previous gas hunt in the country. With the tremendous success at Berland River plus the birth of the country's biggest gas field at Waterton Park behind them, Canadian explorers can expect even more "firsts" in this foothills country from the United States border northwestward to British Columbia.

Northern Alberta's Red Earth Creek

began its second and possibly most important new phase with discovery of oil in the prolific Beaverhill Lake-Middle Devonian rocks of Swan Hills fame. Union Oil Co. of California may have pushed the search for this new Canadian pay zone 115 miles to the north of the fast-moving play at Swan Hills. Recovery on drill-stem test was 1,410 ft. of clean oil. Regular field pay is the Granite Wash.

When freezeup comes to Alberta, look for the biggest play yet in the far north. Home Oil Co. and McColl Frontenac plan a 24-well development program for Swan Hills.

Arizona's biggest and second oil well

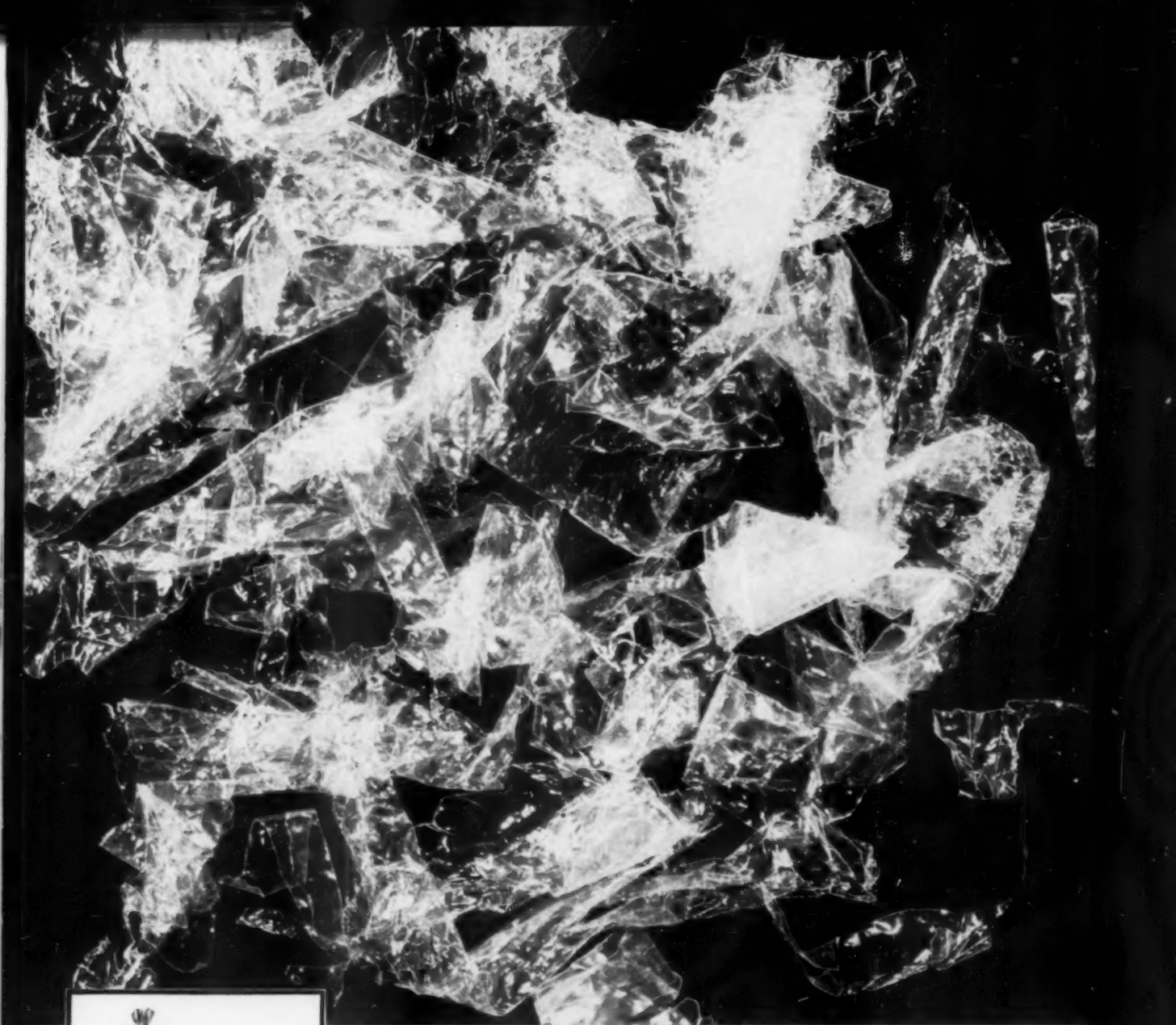
came in with flush production from the Pennsylvanian to give the Paradox basin its big story of the year. Humble Oil & Refining Co.'s Apache County discovery (an extension to the East Boundary Butte area) flowed more than 40 bbl. per hour. This well firmly entrenches Arizona in the oil-producing column, stirring a much-needed reappraisal of the southern edge of the basin, and will likely spur a new frontal attack on the one remaining dry basin in the Four Corners, Black Mesa.

Other September events included

the opening of Mississippi's fourth deep Lower Cretaceous field this year. Central Oil Co. et al. 1 Masonite flowed 10 bbl. of oil per hour from the Bailey (Sligo) sand.

- Another Mississippi discovery pacemaker is Vasser & Howard's oil hit between prolific Little Creek and Sweetwater fields (Tuscaloosa). With oil found at the same depth and in the same pay as the two fields, 1 mile from each, Little Creek and Sweetwater appear headed for linkup into one huge producing area.
- New drilling-depth records for the Texas Panhandle and the Appalachians. Max Pray 1 Mills, Wheeler County, Texas, went to 16,156 ft., surpassing the old Panhandle record hole of 15,997 ft.; New York State Natural Gas Co.'s Steuben County wildcat is below 12,415 ft. giving New York a new depth record . . . this well also surpasses the deepest record in Pennsylvania. There is a definite reawakening of drilling, both deep and shallow, in the Appalachians. One of the best new targets in the East is Pennsylvania's Sabinsville anticline (a 90-mile-long strat trap) where New York State Natural found good gas production.
- Oil production was opened right in the middle of gas country in the southern Green River basin of Wyoming. Caulkins Oil Co. found oil in a southern Sweetwater County wildcat keeping this basin in its lead over other Rocky Mountain centers.
- One of southern Oklahoma's best strikes of the year is Kirby Petroleum Co. 1 Weeden, Jr., a McClain County five-pay Ordovician and Pennsylvanian producer. Kirby's strike is another catalyst to the blooming deep drilling program under way in southern and southwestern Oklahoma.
- Urged on by the recent Llanos field discovery in northwestern Kansas' Sherman County, operators are busy in four counties at a dozen wildcats looking for more Pennsylvanian prospects in this newest oil province. A new pool was opened in Rawlins County during the month firing interest to an even higher pitch.
- The northern end of the Midland basin in West Texas jumped into a brisk hunt for Ellenburger and Strawn oil as a result of recent discoveries in Garza and Lynn counties.
- Alaska's deepest hole was finished at 14,221 ft. California-Standard 1 Deep Creek is another stepping stone in our soon-to-be newest state's oil campaign. The well was dry, but all new provinces must suffer a period of failures on the way up to the oil column . . . Union Oil Co. and Ohio Oil Co. will conduct seismic operations in the Matanuska Valley this winter showing further faith in Alaska's oil future.

BY JOHN C. McCASLIN



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Oil hunting lively in North, West Central Texas

EXPLORATION drilling has made an upturn in North and West Central Texas, along with general development work. The three North Texas counties shown on the accompanying map are fairly representative of any week's developments. By number, these are:

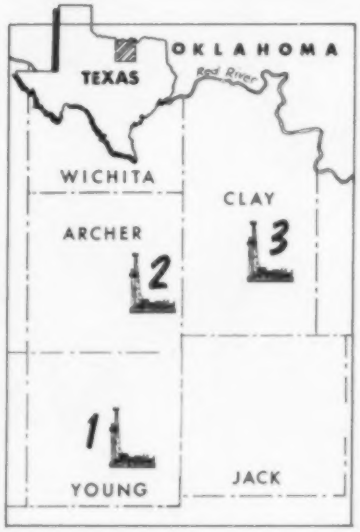
1 . . . Young County. J. W. Hastings et al., Wichita Falls, 1 Blanche McCallister has been completed as a Strawn pay discovery in River Bend field. Regular pays for the area are Pennsylvanian Bend and Mississippian limestone.

Operators drilled 1 McCallister to 4,535 ft., then set pipe at 3,212 ft. Potential test through perforations at 3,118-28 ft. gaged 72 bbl. of 40°-gravity oil a day through 10/64-in. choke. Tubing pressure was 350 psi. Gas-oil ratio was 1,800:1.

Location is 4 miles south of Graham, on an 87-acre lease in the F. L. Thomas Survey, A-1259.

2 . . . Archer County. L. T. Burns Estate 6 Herron has been completed as a Mississippian discovery. Location is 5 miles southeast of Archer City, in Block 5, Clark & Plumb Subdivision.

Potential test on the 6 Herron was 147 bbl. of 42°-gravity oil a day flowing through 8/64-in. choke. Tubing pressure was 800 psi., with gas-oil ratio of 1,125:1. Pay section was open hole between 5,398-5,402 ft.



THREE COMPLETIONS highlighting last week's exploration in North-Central Texas are:

1. A new-pay in River Bend field south of Graham, in Young County, opened by Hastings 1 McCallister.
2. A flowing Mississippian well in southeastern Archer County by L. T. Burns Estate.
3. A Caddo opener southeast of Bluegrove, drilled by 4-B Trust Co.

3 . . . Clay County. No. 1-F Sanzenbacher, drilled by 4-B Trust Co., Wichita Falls, flowed 129 bbl. of 41°-gravity oil a day on final test through 16/64-in. choke. Pay was the Caddo conglomerate at 5,954-64 ft. Tubing pressure was 320 psi. Gas-oil ratio was 980:1.

Location is in the L. N. Sparks Survey, A-401. It is 5 miles southeast of Bluegrove townsite and 1 mile north of Burns-Midway field.

Deep test for Jack County . . . The Texas Co. has filed application to drill a 6,450-ft. wildcat test in extreme northeastern Jack County, 4 miles east of West Newport field. It will be 1 J. E. Lemons, in the G. L. Bledsoe Survey.

Grayson County leasing . . . Humble Oil & Refining Co. has joined the lease play in northwestern Grayson County, following Oil Creek discovery 3 miles east of Whitesboro in June of this year. According to reports, Humble had assembled some 700 acres in the Sadler area, paying from $35 to $50 per acre for 10-year leases.

New interest was generated in the area when John M. Hamilton 1 Nora Wood found good Oil Creek sand pay at 6,149-58 ft. and completed for 315 bbl. a day. The field is now the Gee-Oil Creek Upper and has three producing wells and one drilling.

Wildcat pair hits pay in Alberta

SELECTIVE acreage holdings by two companies in southern Alberta paid off last week at two discovery areas on drilling reservation tracts. The California Standard Co. hit at its wildcat in southeastern Alberta's Sunnynook district; Hudson's Bay Oil & Gas Co. found oil in south-central Alberta at Delburne.

. . . Sunnynook. Cal-Standard's discovery was drilled 4 miles north of gas production at Cessford. It proved production in the basal Blairmore, main pay at Cessford; it also tapped Viking sand gas production.

The 9-23 Sunnynook is located on LSD 9, 23-26-12w4. It lies 6 miles southeast of Sunnynook town and 105 miles east of Calgary. A 105-ft. section of Viking sand was tested. About 85 ft. of this pay appears to be water free. Flow rates of up to 6 M.M.c.f.d. were reported. The operator also got 6,900 M.c.f.d. from the basal Blairmore.

. . . Delburne. The Hudson's Bay discovery is located 9 miles southeast of Joffre Viking sand and Devonian field. The well, 7-29-37-23 Delburne, is on LSD 7, 20-37-23w4. Location is 23 miles southeast of Red Deer City. A 2,300-ft. recovery of oil and 530 ft. of gas and oil-cut mud was reported on drill-stem test in the Viking.

Production casing was set and swabbing operations are under way. Swabbing indicated up to 4 bbl. of oil per hour.

Nebraska names approved

Nebraska's Oil and Gas Conservation Commission approved names for five new fields in the Denver basin. They are:

. . . McMurray in Banner County, opened at Petroleum, Inc. 1 McMurray, C NE NE 28-17n-55w.

. . . Towle in Kimball County, opened at Don Rounds 1 Towle, C SE NE 10-15n-53w.

. . . Maas in Kimball County, opened at Petroleum, Inc. 1 Maas, C NE SW 4-13n-54w.

. . . Hinshaw in Kimball County, opened at Shoreline Petroleum Co. 1 Hinshaw, C NE SE 12-13n-55w.

. . . Leafdale in Kimball County, opened at Falcon-Seaboard 1 Leafdale, C SW SE 22-16n-53w.

. . . Baumgartner in Morrill County, opened at Baumgartner Oil Co. 2 Juelfs, C SE SW 15-17n-52w.

First gasser for north edge of Walhonding

The first gasser along the north edge of Walhonding pool was reported by Lewis Hole on 2 Fee property, Lot 17, third quarter, Tiverton Township, Coshocton County.

Clinton sand was topped at 2,901 ft. and drilled in to 2,953 ft. with the gage showing 3,900 M.c.f. with 990 lb.

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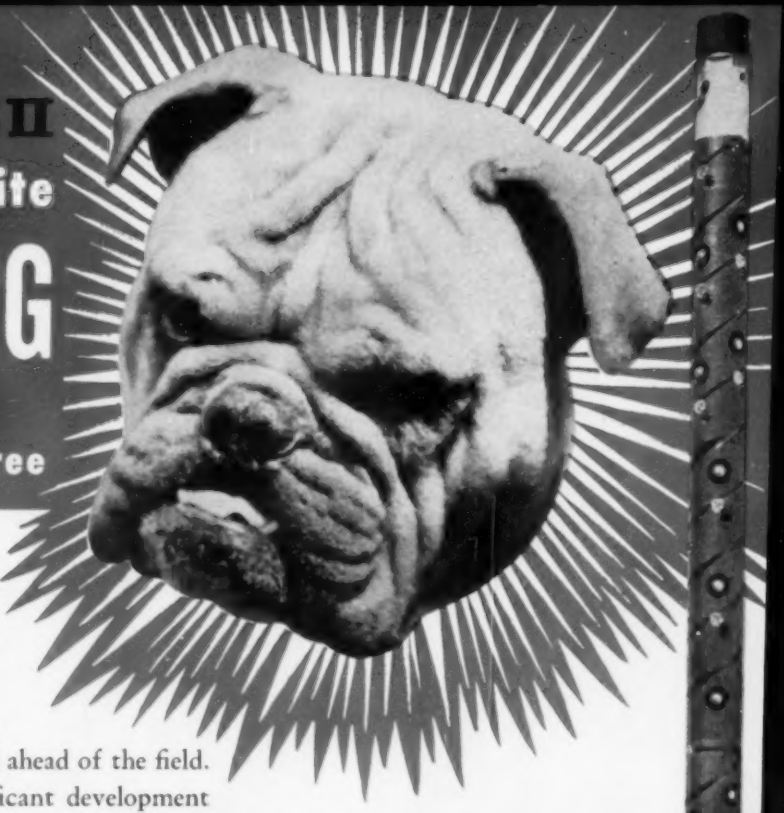

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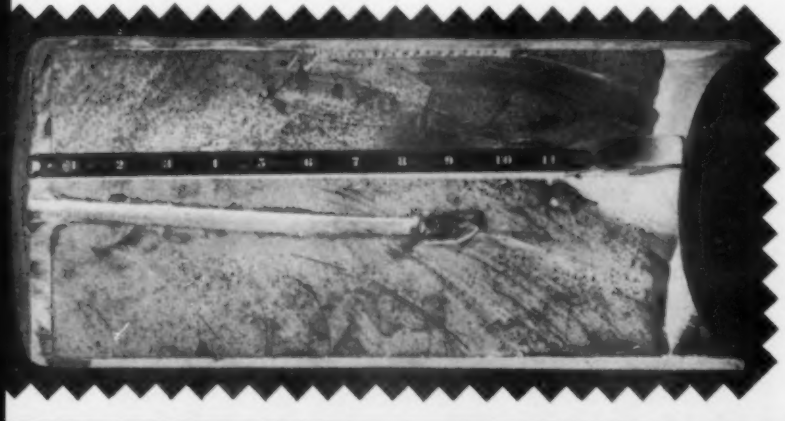

Unretouched photo (lower left) shows the remarkable bullet penetration of over 9" from a 4" O.D. Atlas BULLDOG gun, typical of several test shots *fired under 2500 p.s.i. hydrostatic pressure at 180°F.* Tests with 5-7/16" O.D. Atlas BULLDOG guns produced much deeper bullet penetrations.

The targets were constructed *by a Major Oil Company,* and all tests were conducted recently *under their complete control.*

All targets had 7/16"-thick endplates (from flattened 9⅝" O.D., 43-lb., #N-80 casing) welded to 6⅝" O.D. pipe. Neat cement was cured seven days under water at 160°-180°F. and tested to a tensile strength averaging over 500 p.s.i.

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Extension indicated for Michigan pool

A 1-MILE NORTHEAST extension of Michigan's best 1958 shallow-pool development was indicated with Robert E. Bond 1 Schwass, SW NW NE 11-17n-17w, Mason County, showing 200 ft. oil natural in Traverse from 1,630 to 1,643 ft. Outpost to the Riverton pool will be acidized.

Miller Brothers discovered the pool in January and have completed five commercial wells with three others drilling. Most of the developed acreage is on Superior Oil Co. farmouts.

Drill-stem test at Sun Oil Co.'s 1 Nellist, N½ SW NW 23-24n-1w, Roscommon County, in Traverse limestone showed 1,812 M.c.f. gas and free oil, encouraging new gas-development possibilities on the east end of St. Helen field.

Up to this time the area has been developed primarily for Richfield zone gas and oil at an average depth of 4,200 ft. Drill-stem was made at 2,065-95 ft. following a blowout that cleaned the hole and fired the rig.

Central Louisiana wildcat is tested

THE FRENCH FORK prospect in southeastern LaSalle Parish, Central Louisiana, is proving productive in a wildcat discovery by Olin Oil & Gas Corp. and Tensas Delta Corp., joint owners of the working interest.

The discovery is their No. 9 well on properties of Louisiana Delta Corp., a wholly owned subsidiary of Olin Oil & Gas Corp. Tested through ⅛-in. choke, the well flowed 200 bbl. of 42°-gravity oil per day under pressure of 680 psi.

French Fork prospect is about midway between Catahoula Lake field, on the west, in LaSalle Parish, and Cyprus Bayou field, on the east in Catahoula Parish.

Oil finders get varied program

HERE is a tentative list of papers and authors for the technical program, Southwestern Federation Regional Meeting, October 22-25, Mineral Wells, Tex.

1. Isopachous and Paleogeologic Studies in the Mid-Continent Area, by G. G. Huffman, University of Oklahoma, Norman.

2. Tectonics of North Texas, by C. G. Moon, Humble Oil & Refining Co., Wichita Falls, Tex.

3. Conjectured Middle Paleozoic History of Central and West Texas, by J. L. Wilson, Shell Development, Houston.

4. Ouachita Structural Belt, by P. T. Flawn, Texas Bureau of Economic Geology, Austin.

5. Geology of the South Plains and Texas Panhandle, by R. C. Morris, Pan American Petroleum Corp., Lubbock, Tex.

6. Fundamentals of Core Drilling, by Floyd E. Read, Lubbock.

7. Lower Leonard, Abo Reefing, Stratigraphy and Associated Petroleum Occurrence in Southeastern New Mexico, by F. W. Podpechan, consultant, Albuquerque.

8. Cambrian (?) Sediments in Northwest Texas, Western Oklahoma, Southeast Colorado, and Southwest Kansas, by C. L. Balk, New Mexico Institute of Mining & Technology, Socorro N. M.

9. Southern Portion of the Palo Duro Basin and the Matador Uplift, by R. Zinke, Monterey Oil Co., Midland, Tex.

10. Trans Pecos Area, Texas (Provisional title), by J. P. Brand, Texas Tech. College, Lubbock.

11. Pennsylvanian Stratigraphy of the Forth Worth Basin, by G. L. Turner, Pure Oil Co., Fort Worth.

12. Correlation of the Pennsylvanian in the Subsurface and the Surface of the Llano Area, by W. J. Stewart, The Texas Co., Fort Worth.

13. Oil and Gas Possibilities of Palo Pinto County, Texas, by W. N. Tindall, Mayfair Minerals, Abilene, Tex.

14. Depositional Dips in Limestones, by J. E. Adams, Standard Oil Co. of Texas, Midland, Tex.

15. Pennsylvanian Reef Trends of West Central Texas, by F. B. Conselman, consultant, Abilene.

16. Comparison of Bahamian Land Forms with Those of the Subsurface Pennsylvanian of Nolan County, Texas, by J. W. Harrington, consultant, and E. L. Hazelwood, Lone Star Gas Co., Dallas.

17. The Texas Lineament (Provisional title), by C. C. Albritton, SMU, Dallas.

Perry County field extended in Ohio

A HALF-MILE STEPOUT east of Bristol in Pike Township, Perry County, was announced by the operators Rochester and Lamp.

One 1 J. H. Diller, Section 21, Clinton sand was topped at 3,292 ft. and drilled to 3,319 ft. with 10 bbl. natural and 300 bbl. in a 24-hour test after fracture.

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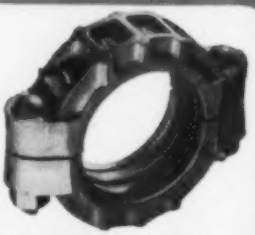

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In Wyoming

Wind River gas strike rumored

THERE are rumors of a gas discovery at the South Badwater Unit wildcat in Fremont County, northern Wind River basin, Wyoming. The California Co. 1 Government, C NE SW 8-38n-89w, 4 miles southwest of the Badwater Unit, Wyoming's deepest producer, flowed 8,500 M.c.f.d. of gas on drill-stem test at about 7,300 ft. The reports are unconfirmed, however.

Location is 4 miles southeast of the second well at Lost Cabin which is reportedly undergoing tests.

...and Green River gets Tensleep strike

O'BRIEN SPRINGS, hailed as Wyoming's most significant oil discovery this year, gaged 492 bbl. of 43°-gravity oil daily from Tensleep-Pennsylvanian at 6,965-7,002 ft.

Atlantic Refining Co. and Fremont Petroleum Co. 3 O'Brien Springs Unit, N½ NE SE 34-25n-86w, Carbon County, Wyoming, flowed through ¼-in. choke. The well will also be tested in the Nugget at 5,418-72 ft. Gas flowed at the daily rate of 2,500 M.c.f.d. at 5,384-5,443 ft.

This important Tensleep strike is in the extreme eastern corner of the Red Desert basin, the east extension of the Green River basin. Its importance is that there is very little Tensleep production in this part of Wyoming. The thick pay at O'Brien Springs indicates tremendous potentialities for this Pennsylvanian reservoir in South Central Wyoming.

Some of the famous Tensleep fields in Wyoming are Lost Soldier and Wertz. Both of these fields have production from every known pay zone in the State of Wyoming. Tensleep has provided prolific production in Big Horn basin fields such as Elk basin near the Montana line. Tensleep rocks lie in every sedimentary and structural basin of the state.

Colorado wildcat taps Pennsylvanian

Important Pennsylvanian oil shows were reported at a Kit Carson County wildcat in southeastern Colorado. It is Honolulu Oil Corp. 1 McConnell, C SW NW 20-10s-47w.

Recovery was 270 ft. of oil on test at 5,510-26 ft. This recovery also included 100 ft. of heavily oil and gas-cut mud.

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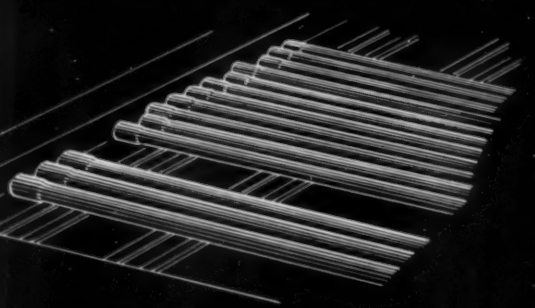

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BAASH-ROSS JOY

Here are Texas Panhandle hits

in Ochiltree . . .

THE TEXAS PANHANDLE'S Ochiltree County has a new Chester-Mississippian gas-condensate field discovery at Shell Oil Co. 1 J. H. Kershaw.

This new strike flowed 2,358 M.c.f. of gas daily plus 32 bbl. condensate on ½-in. choke from perforations at 8,305-19 ft. It is also an indicated Morrow producer at 8,142-64 ft. Location is in Section 46, Block 10, HT&B Survey, 5 miles northeast of Perryton.

and Lipscomb counties

A DUAL GAS DISCOVERY was reported by Apache Oil Corp. of Tulsa in Lipscomb County, in the Texas Panhandle's Anadarko basin.

Apache's 1 Bradford, C NE NE Section 686, Block 43, ran a drill-stem test of the lower Morrow at 9,683-7,155 ft., gaging gas at the rate of 14 M.M.c.f.d., natural flow.

Previously, the Tonkawa was drill-stem tested at 6,468-94 ft. to gage 4,460 M.c.f.d. of gas.

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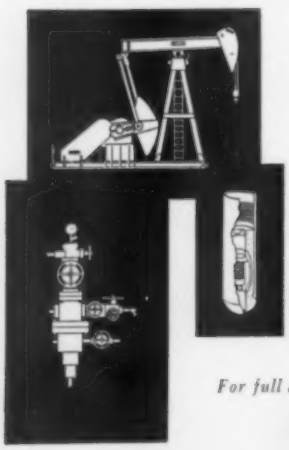
says Mike LE GRAND



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Big Flat confirmed

UTAH'S second Mississippian oil producer was completed in Grand County. The well is Pure Oil Co. 2 Big Flat Unit, C SW NE 14-26s-19e. This confirmation strike to last year's Big Flat discovery made 85 bbl. of oil per day on ½-in. choke from perforations at 7,750-62 ft. The discovery well made 319 bbl. per day on completion.

Three counties lead New Mexico play

WEEK'S DEVELOPMENTS included wildcat completions for Lea, Eddy and Roosevelt counties in southeastern New Mexico.

Roosevelt County . . . The Texas Co. 1 Champeau-Federal made a small well in the Pennsylvanian. On pumping tests it gaged 16 bbl. of 42°-gravity oil, through perforations at 9,508-36 ft.

Location is 12-8s-35e, which is about 1 mile southeast of the town of Milnesand and 5 miles east of the Milnesand-Pennsylvanian field.

A second well for a new Permian pool southwest of Milnesand field has been completed by N. M. Associates as the 1 Newman, 23-8s-34e. On final pumping test the well made 59 bbl. of 29°-gravity oil, plus 2 bbl. of water through perforations at 4,610-20 ft.

The same firm's 1 Weathersby opened small production in July from pay at 4,554-4,620 ft.

New exploration work in Roosevelt County included a 11,500-ft. wildcat to be drilled 2½ miles southeast of Bluitt. Ohio Oil Co. filed application to drill their 1 McGrail-Federal in SE NW of 20-8s-27e. Nearest production is in the Allison field, 3 miles to the southwest.

Eddy County . . . General American Oil Co. of Texas has completed its 1 Brewer-Federal for 360 bbl. of oil a day from a shallow Permian zone between 2,061-84 ft. Operators reported a 500-gal. acid job on the open-hole section, followed by fracture treatment with 37,000 gal.

Location is 2 miles east of High Lonesome field, in 14-16s-29e.

Joseph I. O'Neill, Jr., 2-D Federal, prospective Morrow gas discovery in Eddy County, continued testing. After being shut in for 24 hours, the well flowed at the rate of 2,486 M.c.f.d. from perforations at 11,566-80, 11,-860-64 and 11,834-48 ft. Tubing pressure on 48/64-in. choke was 950 psi. Location is 1 mile east of shallow gas

production in Black River field, in 12-24s-26e.

Lea County . . . Atlantic Refining Co. 1 Lowe Land Co., 12 miles southeast of Tatum, rated 324 bbl. of 40°-gravity oil a day, based on an 11-hour flow which tanked 149 bbl. of oil. The gage was through ¼-in. choke, from perforations in the Permo-Pennsylvanian at 9,838-62 ft. Flowing pressures were not reported. The well had been drilled to 12,902 ft. before being plugged back.

Location is in 24-13s-37e, 4 miles west of Bronco field and 1 mile north of King field.

Gas in Oklahoma

NOT ALL of the country's big gas wells are in Texas or north of the border in Alberta. One of the most prolific new gas areas in the nation is the Laverne district of northwestern Oklahoma. This Harper County Pennsylvanian area has been clicking off big gassers for 3 years.

One of the best new additions to the big reservoir is Cities Service Oil Co. 1 Dunnaway-B in C NW SE 9-26n-25w. Initial flow was 72 M.M.c.f.d. of gas from 4,118-43 ft. Pay is the Hoover sand. Previously, the well flowed 32 M.M.c.f.d. on potential tests of the Morrow sand at 6,849-68 ft.

Texas bits tap a Panhandle strike

ATOKA-PENNSYLVANIAN oil production was opened in north-central Lipscomb County in the northeast corner of the Texas Panhandle.

The Texas Co. reported completion at its 1 Anna Frass, 1½ miles northeast of Darrouzett, Tex. The well flowed 304 bbl. of oil daily on ½-in. choke from perforations in this basal Pennsylvanian sand at 7,903-14 ft.

Nearest oil production in Lipscomb County is 12 miles southwest. The new discovery is just 2¼ miles south of the Oklahoma Panhandle line.

. . . and coastal field

PRODUCTION in the widespread Alta Loma area of Galveston County, Texas, is being extended another 2 miles southeast in a possible new-field discovery.

The discovery is by Texas Eastern Transmission Co. at its 1 E. W. Craig, which flowed 277 bbl. of 33.8°-gravity oil per day from Frio sand, perforated at 9,263-84 ft. Flow was through ⅛-in. choke with gas-oil ratio of 2,230 cu. ft. per barrel and pressure of 3,125 psi.

Location is 4 miles southwest of Hitchcock. The deep multiple-pay Alta Loma field is the nearest production.

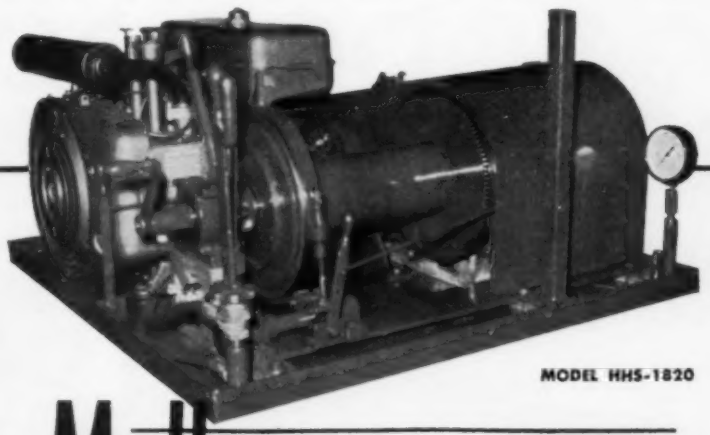
Texas Eastern already is drilling on its second well and has location for another in the immediate area.

Oil in Paradox

PARADOX-PENNSYLVANIAN oil production is reported at a southwestern Colorado wildcat. It is The California Co.'s 2 Calco-Superior-Ute Tribal in C NE NE 15-33½n-20w, Montezuma County. The well reportedly pumped 94 bbl. of new oil and 44 bbl. of load water in 24 hours on tests. The operator is continuing pump tests.

Paradox perforations are at 5,761 to 5,838 ft. Location is in the Paradox basin, 2 miles east of the Utah-Colorado state line. It is also 1½ miles east of the 1 Calco-Superior-Ute Tribal which found good Pennsylvanian oil shows earlier this year.

There is practically no oil production in the Colorado portion of the Paradox basin. The only producing areas within the basin limits in Colorado are Mancos Creek and at Dove Creek, neither of which is considered important.



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Drillers move uptown in California oil hunt

OPERATORS are continuing their search for additional reserves in the areas of old, largely abandoned Los Angeles Basin oil fields, but with very limited successes thus far.

A rundown on current wildcats in residential areas of the city looks like this:

Signal Oil and Gas Co. was being credited with a major new discovery in the Los Angeles Basin with a successful wildcat drilled on the 160-acre municipal Rancho Golf Course in West Los Angeles.

The Signal well, 1 Signal-Richfield-Rancho, tested at rates up to 1,010 bbl. daily on a formation test of a 230-ft. interval bottomed at about 9,500 ft. After cleaning up for 12 hours, the well settled down to a stabilized rate of 343 bbl. daily of clean 34°-gravity crude with 508 M.c.f.d. of gas. Tubing pressure was 475 psi. Selective testing of other intervals will continue in the 12,688-ft. wildcat.

Signal is operator on the golf course for itself and Richfield Oil Corp. The Rancho lease is part of a 2,500-acre block the two companies hold in the area.

If the Rancho wildcat holds up and proves out as a commercial discovery, it will give Signal a score of two out of two on its efforts to develop production adjoining Universal Consolidated Oil Co.'s 20th Century Fox production.

While nothing has been given out yet by Signal, reports are that the operator also has an encouraging structure in its wildcat on the Hillcrest Country Club next to the Rancho course.

The third operator in this play, Hudson Gas & Oil Corp. was drilling below 3,625 ft. on its second test of the Los Angeles Country Club. The L.A. course is on the north flank of Universal's movie lot production while the Hillcrest-Rancho courses being drilled by Signal are to the south of the lot.

... Still nearer the Universal Consolidated play at the film studio Signal was slant drilling ahead below 7,096 ft. on 1 Signal-Richfield-Hillcrest, a wildcat on the privately owned Hillcrest Country Club adjoining the Rancho course and the movie lot. Scouts report this wildcat thus far has offered more promise than the Rancho test. Both this and the Rancho effort are in a quality residential section of West Los Angeles on the border of Beverly Hills.

... On restaurant row in West Los Angeles, Morgan Brown resumed operations on 1 U-6 Oil District and was drilling below 10,070 ft. This wildcat is in the area of the old Salt Lake field.

... Eastward toward downtown Los Angeles, Guiberson & Burke Co., was drilling below 6,379 ft. on a wildcat near the intersection of Third and Vermont. This is in the limits of the Los Angeles oil field.

All of these wildcats have several things in common. They are being drilled in areas of old production in efforts to find deeper pays. For instance, the golf course tests are associated with production tapped by Universal Consolidated when it drilled deeper into the virtually abandoned Beverly Hills field. It was originally discovered in 1908 and at one time had 32 producers averaging 35 bbl. daily each. There are now only 2 wells left in the old shallow zone but they are both still making 37 bbl. a day each.

Morgan Brown's wildcat along La Cienega Boulevard on the West Los Angeles-Beverly Hills border is a deep

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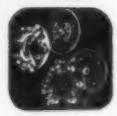
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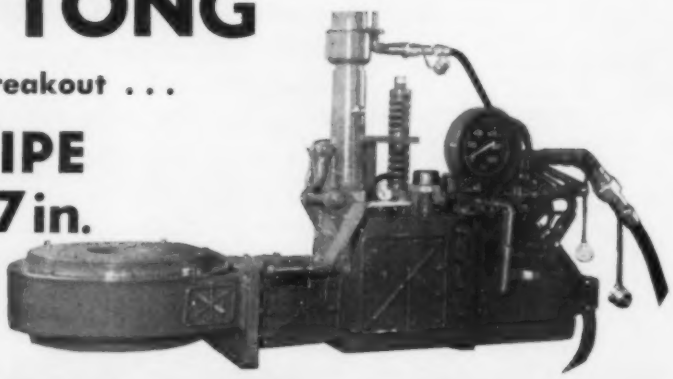

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test of the Salt Lake field. It was discovered in 1903 and at one time had 350 producing wells in the shallow zones. There are seven of these old wells left each making 30 bbl. daily.

The Guiberson & Burke well at Third and Vermont is in the area of the Los Angeles oil field which was tapped in 1892. At its peak it boasted of nearly 1,000 wells of which 80 stripper wells survive today making 2 bbl. daily each.

Another discovery for Tejon . . . Drilling and Production Co. took the spotlight away from the North Tejon field, at least for the moment, with a Valv sand discovery in the central portion of Tejon field 3 miles to the south.

California drillers probe ocean sites

OFFSHORE DRILLING in California waters was on the upswing with two wildcats under way, another rigging up and locations announced for two more.

Standard Oil Co. of California was the only active driller at this writing. It was drilling below 4,300 ft. on its valuation test of the 3,840-acre lease it holds with Humble Oil & Refining Co. off Gaviota and was drilling below 1,500 ft. on the first test of the 5,500-acre lease it and Humble holds off Summerland. Both parcels are in waters off Santa Barbara County.

Within eyesight of Standard's Summerland operations, Richfield Oil Corp. was rigging a rotary to begin the first test of its 1,170-acre offshore lease it holds at Rincon.

In a unique situation, all three of the mentioned tests are being drilled from a different type structure. The Standard wildcat off Gaviota is being drilled from a mobile platform, the Standard wildcat off Summerland is being drilled from a permanent platform and the Richfield test will be drilled from an earth-filled island.

Phillips Petroleum Co. has announced locations for the first tests of the two offshore parcels it holds off Santa Barbara County. These two parcels are on either side of Standard's parcel off Gaviota. Phillips will be operator on the two parcels, listed as A and E on the state records, for itself and a host of others including Kerr-McGee Oil Industries, Inc., and E. W. Pauley.

Actually, the Standard test on its Gaviota parcel is not slated to be completed as an oil well, even if a structure is tapped. It is designed to evaluate the lease and locate a site for a permanent platform for development drilling.

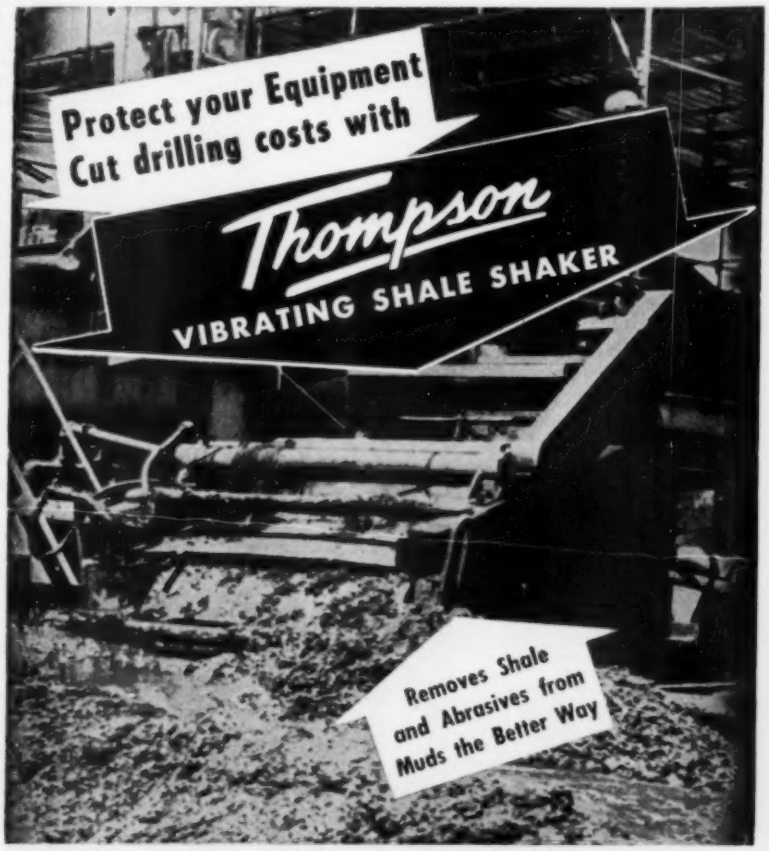
Border well being completed

THE SECOND WELL for the Texas side of the new Alligator Lake field is being completed as a gas-condensate producer. The initial Texas extension well and the field's discovery, and only other well, located in Louisiana, are oil producers.

The two Texas-side wells are on the west bank of Sabine River (state line), in Newton County, about 3 miles southeast of Bon Weir. Both were drilled by Oil Reserves Corp. on its Kirby-Pollard lease. The first (1-K) was completed last June flowing more than 215 bbl. of 42.2°-gravity oil per day through 11/64-in. choke from Wilcox sand at 10,655-62 ft.

This well is 800 ft. west and 400 ft. south of the field's discovery well, across the river in Beauregard Parish, Louisiana. The latter was drilled by Russell Maguire and completed last February making more than 180 bbl. of 38.4°-gravity oil per day through 11/64-in. choke from the same pay, perforated at 10,684-92 ft.

The new Texas producer is productive at 10,660-66½ ft., and is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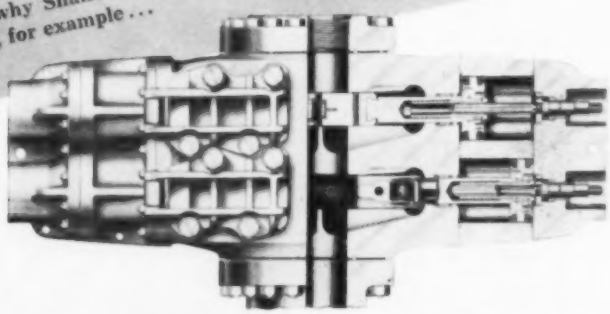

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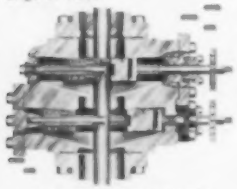

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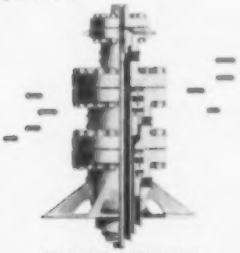

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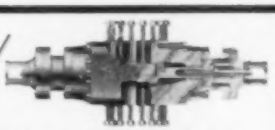

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On the Louisiana side, Maguire is drilling on his second well (2 Crawford), located southeast of his discovery well.

Midland County Prospect Still Testing

MIDLAND COUNTY gained a small Strawn discovery, but operators are still testing the well from the Devonian section.

Zapata Petroleum Corp. 1 Ida Mae Oldham, 12 miles east of Midland in 34-37-T1S-T&P Survey, was completed from the Strawn last week when it flowed a little better than 29 bbl. of oil a day through 12/64-in. choke, from perforations at 10,228-10,315 ft.

Operators will attempt dual completion, from Devonian perforations at 11,166-11,260 ft. Recent tests on the lower set of holes produced 13 bbl. of fluid in 24 hours, being about 85% new oil. Nearest Devonian production is 2 miles to the west in the 1-well Germania field.

Howard County has Wolfcamp flow

WOLFCAMP OIL in northeastern Howard County was reported by Nortex Oil & Gas Corp. 1 J. M. Sterling, located 22 miles northeast of Big Spring. On drill-stem test at 5,918-40 ft., gas surfaced in 3 minutes and oil in 2 hours and 40 minutes.

The well flowed 2 bbl. of oil, by heads. Flowing pressure ranged from 0 to 800 psi., with shut-in pressure of 1,490 psi. in 30 minutes. Operators drilled ahead on a 7,800 ft. contract.

No. 1 Sterling is approximately 1 mile north of Pennsylvanian production in the Vincent area. Location is Section 59, Block 20, Lavaca Navigation Co. Survey. Shallow production in this area is assigned to the Coronet field. Nearest Wolfcamp production is 3½ miles to the west in the 1-well Vincent, North field, but separated by depleted Pennsylvanian wells.

Strike in Lafayette

LAFAYETTE, one of South Louisiana's principal oil centers, now has a producing well inside its city limits. It is a new-field discovery completed by The Texas Co. and Seaboard Oil Co., with gas-condensate production from sand at 10,599-10,603 ft.

The well, 1 Edwin Roy, in 28-9s-

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4e, is on the west edge of the townsite, 4½ miles from nearest production, located in Scott field to the west. Tested through ⅛-in. choke, it flowed 90 bbl. of 52°-gravity condensate per day with 235 M.c.f. of gas. Hole was drilled to 13,299 ft.

B. C. wildcat is dually completed

A WILDCAT discovery on the southeast part of a solid block of permits covering 443,125 acres in British Columbia was completed by Sinclair Canada Oil Co., subsidiary of Sinclair Oil & Gas Co.

The well, Sinclair and others 2 B-13, located in 94-G-1-D-50, 80 miles northwest of Fort St. John, B. C., was dually completed from two sections of the Triassic. The well had an open flow potential of 4,950 M.c.f.d. of gas from the Triassic "A" zone at 5,422-82 ft., and flowed 7 M.M.c.f. from the Triassic "D" section at 6,501-42 ft.

Sinclair Canada owns approximately half interest in the well and block. The discovery is located on the Alaska highway near Mile 142 in northeastern British Columbia.

Danbury gets record well

A WELL flowing 830 bbl. of oil per day through ⅛-in. choke has been completed on the Danbury dome in Brazoria County, Texas Gulf Coast. It is this dome's most prolific producer, and one of the largest brought in on the Texas coast this year.

The well is Humble Oil & Refining Co.'s 14-B Bassett Blakely. Location is on a 60.95-acre lease about 2 miles northeast of Danbury townsite.

Production is from a flanking Miocene sand, perforated at 5,353-63 ft. Gravity of the oil is 40.9°. Flow was with gas-oil ratio of 439 cu. ft. per barrel, and pressure of 680 psi.

New gas-condensate area discovered

DISCOVERY of a new gas-condensate producing area in Brazoria County, Texas Gulf Coast, is reported by Lion Oil Co., a division of Monsanto Chemical Co., and Republic Natural Gas Co., joint operator.

It is about 8 miles west of West Columbia, in the northwestern part of the county, where their 1 McDonald has been completed with open-flow potential of 27 M.c.f.d. of gas from Frio sand at 9,922-34 ft.

Liquid recovery is at the rate of 18½ bbl. per 1 M.c.f. of gas. The well, shut in, has pressure of 4,880 psi.

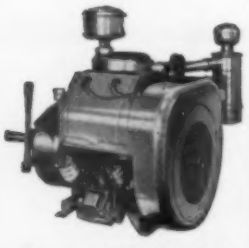
Location is about 2 miles southeast of the Pledger gas field, and about 4 miles north of the widespread Old Ocean field. It lies in a triangle formed by these fields, and West Columbia field, about 5 miles east.

North Dakota wildcat hits in dry-hole area

Madison-Mississippian production is indicated at a North Dakota wildcat, the Skelly Oil Co. 1 Tank in C NE NW 34-152n-96w, McKenzie County.

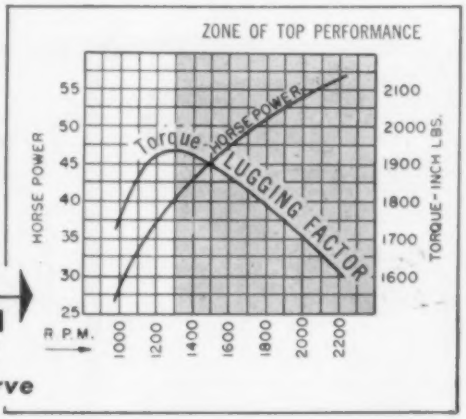
The well gaged 48 bbl. of oil in the last 4½ hours of a 9½-hour test of perforations at 9,167-97 ft. Flow was on ½-in. choke. This discovery prospect is 4 miles west of Blue Buttes field in an area removed from production by dry holes.

Judge your power unit by its LUGGING FACTOR!



Model VR4D 56 hp

WISCONSIN heavy duty Air-Cooled ENGINE power curve



When the power load suddenly *builds up* and the engine speed *slows down* . . . how long will the engine *hang on* and carry the increased load without stalling?

The answer lies in the HIGH TORQUE LUGGING FACTOR which is an integral part of "Wisconsin" basic engineering. The point at which an engine will stall under suddenly increased loads is the *High Point* in the TORQUE CURVE. As a case in point, analyze the Wisconsin Model VR4D power curves reproduced here.

This engine develops its maximum horsepower (56 hp.) at 2200 rpm. at which point it registers a torque of 1600 inch-lbs. The engine runs into heavy going. The load builds up fast. The rpm. slows down to 2000, 1800, 1600 and 1400 rpm., reaching its maximum torque *at the low speed* of 1300 rpm.

In terms of power service to the user, this simply means that your Wisconsin Engine is designed *to provide dependable load-holding power at low engine speeds.* This, in turn, means fewer shutdowns, less wear and tear, more usable power and more versatile performance for your dollar investment.

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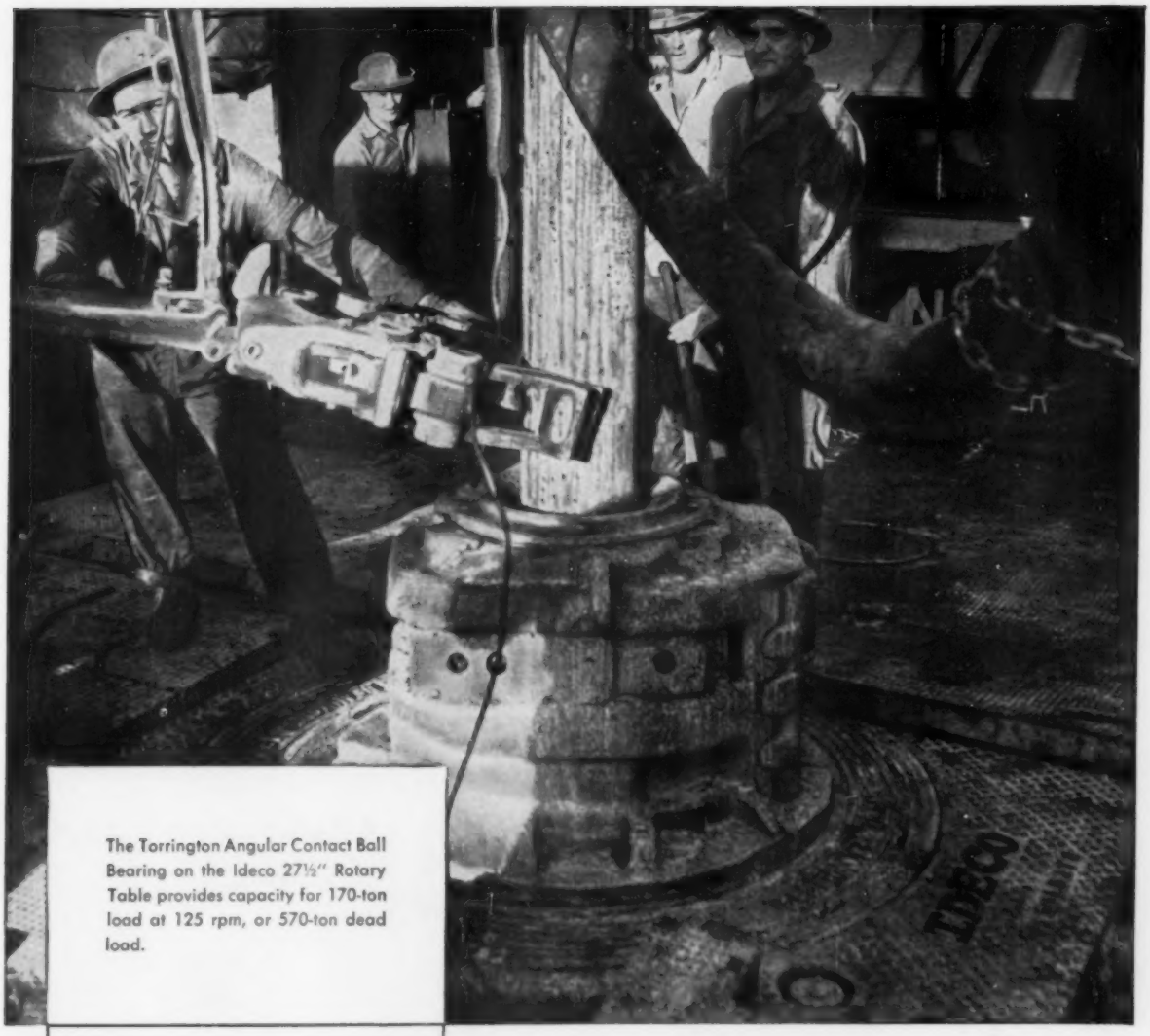

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Opener completed in Runnels County

NORTHEASTERN Runnels County reported a Gardner sand discovery at Murray Petroleum Co., San Angelo, 1 Mrs. Glenn Eager. This was a workover well 7½ miles northeast of Winters in W. H. Gee Survey 1.

Potential was 157 bbl. of 41°-gravity oil in 24 hours flowing through 16/64-in. choke. Tubing pressure was 225 psi. Gas-oil ratio was 350 : 1. The well was originally completed dry in 1954 at 4,678 ft.

New exploration . . . American Trading & Production Co., Midland, has announced location for a 5,200-ft. Ellenburger test in west-central Runnels County. The well will be drilled as 1 Molly F. Mitchell, on a 195-acre lease in Block 3, Burnett CSL Survey. Location is 2½ miles northwest of Norton and 3½ miles west of North Norton field.

Oil hunting in Ellis

NEW ELLIS COUNTY exploration in northwestern Oklahoma is slated by Pan American Petroleum Corp. The Tulsa firm will drill a wildcat north of new West Shattuck field in 12-21n-26w. Location is on the Coffman farm.

Meanwhile, at West Shattuck itself, Magnolia Petroleum Co. 1 Brown, C NW SE 23-21n-26w, found the Chester-Mississippian at 10,068 ft., went on down to 10,247 ft., ran log to 10,242 ft., and is running casing. This is the first offset to the field discovery well which is at Magnolia 1 Schoenhals, C NE SW 24-21n-26w. That well flowed 13,000 M.c.f. of gas daily from Morrow-Pennsylvanian perforations at 9,243-61, 9,582-9,608, 9,683-93, and 9,762-75 ft. The discovery also had commercial distillate production.

. . . **Magnolia** is reportedly preparing to drill a deep test northwest of Arnett in Ellis County. The wildcat, 6 miles northwest of that town, will go to 11,000 ft. for a look at the Chester.

Oklahoma area opens

LOCATION has been reportedly made for an important wildcat in a new producing area of the near-barren Palo Duro basin portion of southwestern Oklahoma.

J. D. Kennedy tentatively has a spot picked for the 1 Hulett in NW NW 22-1n-23w, Jackson County. The well will go to 5,800 ft. Mississippian production was opened recently in 5-1n-23w, several miles from existing Oklahoma production.

Alfalfa County hits

PENNSYLVANIAN OIL production was opened near Driftwood in Alfalfa County, extreme northern Oklahoma. Woods Petroleum Co. 1 Cloyd, C NW SE 26-28n-11w, is a new pool-opener in the Pennsylvanian trend of this northern county.

The strike flowed 5 bbl. of oil per hour on final test through 19/64-in. choke from perforations at 5,027-28 and 5,033-38 ft.

Successful wildcats

ALBERTA

Honolulu et al. 7-9-22-26 Carseland, LSD 7, 9-22-26w4. Detrital oil discovery. TD 6,205 ft.

CPOG 11-29 Countess. LSD 11, 29-22-17w4. Basal Colorado gas discovery. TD 3,985 ft.

BRITISH COLUMBIA

Fargo et al. 24 South Blueberry, LSD 10, 12-88-23w6. Triassic gas discovery. TD 5,470 ft.

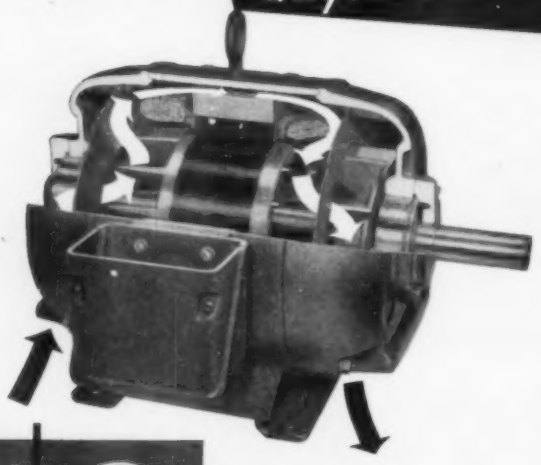
CALIFORNIA

Kern County: Drilling & Production Co. 36-33 "O.M.B.," NE SW 33-11n-19w, 387 bbl. daily net, 11% cut, 28-30° gravity, perfs. 4,765-4,811 ft. and 4,819-43 ft., TD 5,379 ft. (New fault block discovery in the central area of the Tejon field.)

SOUTH LOUISIANA

Lafayette Parish: The Texas Co. et al. 1 Roy, 28-9s-4e. IP 90 BOPD and 235 M.c.f. daily, ⅛-in., 52°, TP 1,800 psi.,

Grease lasts 52% longer because- they run cooler!



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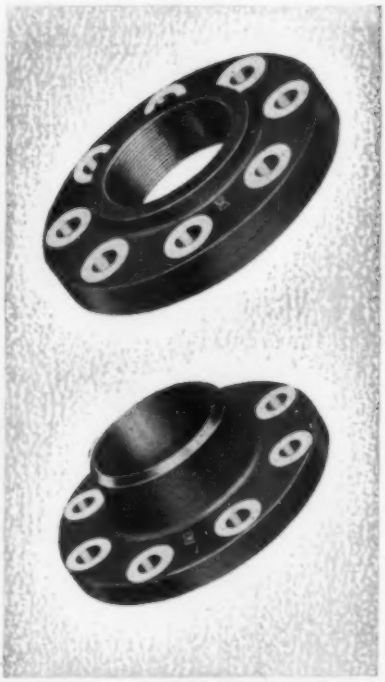

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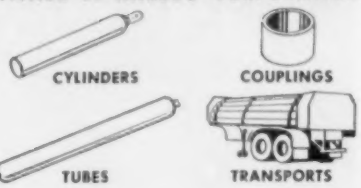

perfs. 10,599-10,603 ft. TD 13,299 ft. (New field.)

Plaquemines Parish: John W. Mecom and Ernest Cockrell, Jr., 2 Vaccaro, 1-17s-26e. IP 161 BOPD and 1,550 M.c.f. daily, 5/32-in., 38°, TP 3,700 psi., perfs. 11,739-45 ft., and (dual completion) 337 BOPD and 3,485 M.c.f. daily, 7/32-in., 53.2°, TP 3,700 psi., perfs. 10,814-18 ft., TD 12,622 ft. (New field.)

St. Landry Parish: Tommy Neal 1 Haas Hirsch, 4-6s-5e. IP 50 BOPD, 7/64-in., 37.4°, GOR 300 cu. ft. per barrel, TP 400 psi., perfs. 4,822-28 ft. TD 5,300 ft. (New pay in Port Barre field.)

Terrebonne Parish: Placid Oil Co. et al. 1 Linwood Lapeyrouse et al., 103-20s-18e. IP 3,240 M.c.f. daily, spray condensate, 5/32-in., 50°, TP 5,100 psi., perfs. 15,608-30 ft. TD 15,924 ft. (New pay in Lapeyrouse field.)

Vermilion Parish: Superior Oil Co. 7 State Lease 3057, White Lake. IP 37 BOPD and 3,518 M.c.f. daily, ¼-in., 42.1°, TP 2,650 psi., perfs. 13,850-66 ft. TD 14,200 ft. (New pay in Lac Blanc field.)

Union Oil Co. of California 2-F Louisiana Furs, Inc., 4-16s-2e. IP 340 BOPD and 283 M.c.f. daily, 3/32-in., 41.8°, TD 4,800 psi., perfs. 13,972-82 ft. TD 14,259 ft. (Second well and new pay in North Fresh Water Bayou field.)

Sinclair Oil & Gas Co. 1 Hargrove Unit 1, 2-11s-2e. IP 64 BOPD and 3,315 M.c.f. daily, 5/32-in., 46.3°, TD 7,200 psi., perfs. 10,440-45 ft. TD 15,800 ft. (New pay in North Andrew field.)

LOUISIANA OFFSHORE

Main Pass Area: Cities Service Producing Co. 1 State Lease 2715, Blk. 45 Main Pass Area, Gulf of Mexico. IP 145 BOPD and 21.4 M.c.f. daily, 32.8°, TP 1,310 psi., perfs. 8,772-76 ft. TD 10,000 ft. (New offshore field.)

Marsh Island Area: The Texas Co. 1 State Lease 340-S, Marsh Island Area, Gulf of Mexico. Shut-in gas well, no gage, perfs. 8,506-16 ft. TD 12,866 ft. (New field—first in Marsh Island Area.)

Vermilion Area: Superior Oil Co. 1-B OCS-0249, Blk. 76, Vermilion Area, Gulf of Mexico. Potential gas well, no gage, hole cased but not perforated. TD 11,000 ft. (New field—gas indicated in open-hole test.)

SASKATCHEWAN

W. H. Hudson-Riddle 6-4 Rocanville, LSD 6, 4-16-31w1. Mississippian oil discovery. TD 2,300 ft.

Nuco 7-27-11-29 Cypress, LSD 7, 27-11-29w3. Medicine Hat gas discovery. TD 1,760 ft.

Nuco 10-17-11-29 Cypress, LSD 10, 7-11-29w3. Medicine Hat gas discovery. TD 1,850 ft.

TEXAS

Andrews County: Texas Crude Oil Co. and B. L. McFarland, Inc. 1-6 University, Sec. 6, Blk. 3, University Lands, 6 miles east Andrews. IP 193 BOPD, ¾-in., 34° gravity, GOR 1130, TP 100 psi., Wolfcamp 8,458-98 ft. TD 10,812 ft., ground elev. 3,113 ft.

Borden County: William A. and Edward Hudson 1 Clayton & Johnson, Sec. 30, Blk. 30, T6N, J. H. Gibson Sur., 10 miles north Gail and ¾ mi. southwest Dunigan field. IP 305 BOPD, 14/64-in., 42.7° gravity, GOR 106, TP 900 psi., Ellenburger 8,735-57 ft. TD 8,765 ft., ground elev. 2,610 ft. Will be completed from Strawn at a later date.

Lone Star Producing Co. 1 Clarence Porter, Sec. 9, Blk. 32, T3N, T&P Sur., 12 miles southwest Gail. IP 297 BOPD, ¼-in., 43° gravity, GOR 627, TP 220 psi., Fusselman 9,744-50 ft. TD 10,004 ft. Ground elev. 2,497 ft.

Midland County: E. P. Campbell and Leland Fikes 1 Terry Elkins, Sec. 33, Blk. 38, T1S, T&P Sur., 2 miles northeast Midland. Recompleted as gas discovery. IP calculated open-flow 4,000 M.c.f. gas; estimated 16 bbl. condensate per day flowing through 18/64-in. choke. Gas-liquid ratio 5,260 : 1. Strawn 10,450-69 ft. Old TD 12,650 ft.

Terrell County: Richardson & Bass 1 Goode, Sec. 6, Blk. 4, TCRR Sur., 4 miles northwest Brown-Bassett Silurian gas production, 24 miles south Sheffield. IP calculated open-flow 5,500 M.c.f. gas, Ellenburger, 13,578-14,803 ft., TD. Top Ellenburger 13,497 ft., elev. 2,505 ft.

TEXAS GULF COAST

Aransas County: C. G. Glasscock et al. 1 State Tract 123, Aransas Bay (2 miles east of Fulton). Absolute open-flow potential 11,500 M.c.f.d., GLR 15,830 cu. ft. per bbl., 67.1°, shut-in TP 1,969 psi., perforations 5,622-24 ft. (Catahoula), and 9,200 M.c.f.d., GOR 127 M.c.f. per bbl., 58.6°, shut-in TP 1,953 psi., perforations 5,123-25 ft. TD 7,520 ft. (New pays at Half Moon Reef field.)

Galveston County: Texas Eastern Transmission Corp. et al. 1 E. E. Craig et al., Sarah White Sur., A-207 (4 miles southwest of Hitchcock). IP 277 BOPD, ⅛-in., 43.8°, GOR 2,230 cu. ft. per bbl., TP 3,125 psi., perforations 9,263-84 ft. TD 10,050 ft. (New oil discovery 2½ miles southeast of Alta Loma field.)

Kleberg County: McKeen Oil Co. et al. 1

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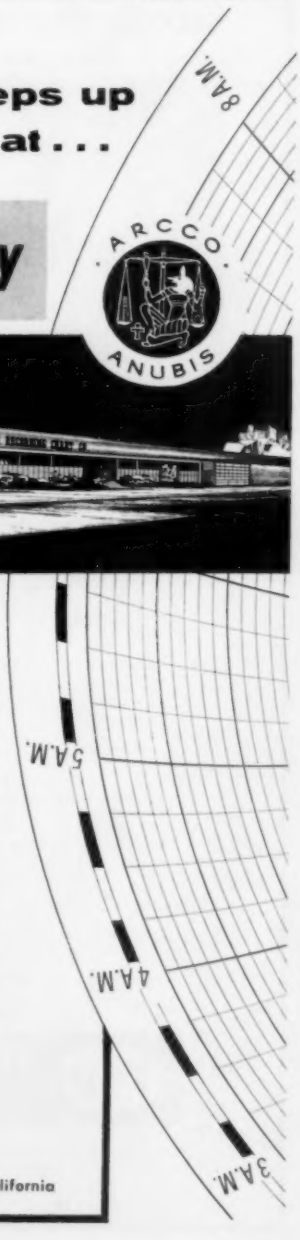

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Yeary, Lot 1, Section 36, Theodore F. Kochs 2nd Subd., Riviera Farm Lands (8½ miles northeast of Riviera). Absolute open-flow potential 3,200 M.c.f.d., GLR 48.2 M.c.f. per bbl., 56.8°, shut-in TP 3,200 psi., perforations 8,770-82 ft. (Frio-Walsh sand). TD 9,541 ft. (New field 1¼ miles northeast of May field.)

Lavaca County: North Central Oil Corp. 1 Karney et al., Nicaolas Martinez Sur., A-311 (7 miles southwest of Speaks). Absolute open-flow potential 6,300 M.c.f.d., 17.38 BC per M.M.c.f., 54.7°, shut-in TD 2,966 psi., perforations 8,229-40 ft. (Wilcox). TD 8,974 ft. (New reservoir in Southwest Speaks area.)

Christie, Mitchell & Mitchell 3 Cranz, George Billups Sur., A-91 (17 miles southeast of Halletsville). Absolute open-flow potential 8,500 M.c.f.d., dry gas, shut-in TP 1,220 psi., perforations 3,005-13 ft. (Frio). TD 10,017 ft. (New pay and extension in Southwest Speaks field.)

Live Oak County: Hillcrest Oil Co. 1 Harlan-Nelson, Lot 804, Block C, George West Subd., L. A. Fant Sur., A-601. Absolute open-flow potential, GLR 39.97 M.c.f. per bbl., 59.8°, shut-in TP 2,665 psi., perforations 7,584-89 ft. (Massive Wilcox), and (dual completion) 3,500 M.c.f.d., GLR 147.93 M.c.f. per bbl., 60.2°, shut-in pressure 2,142 psi., perforations 7,224-39 ft. (Wilcox-Luling sand). TD 7,868 ft. (New field.)

Matagorda County: Roy R. Gardner and Cyprus Oil Co. 1 Pierce Estate, J. W. E. Wallace Sur., A-99 (1½ miles southeast of Midfield). Absolute open-flow potential 7,500 M.c.f.d., GLR 129 M.c.f. per bbl., 48.9°, shut-in TP 2,419 psi., perforations 6,814-19 ft. TD 6,885 ft. (New reservoir ¾ mile south of North Tidehaven field.)

Newton County: Oil Reserve Corp. 3 Kirby-Runnels, Matilda Runnels Sur., A-14 (10 miles southeast of Call). Absolute open-flow potential 10 M.M.c.f.d., GLR 12.7 M.c.f. per bbl., 67.8°, shut-in TP 2,563 psi., perforations 7,640-42 ft. (Yegua). TD 8,350 ft. (New field—Clay Point.)

Nueces County: Carrl Oil Co. and George H. Coates 1 Lawrence, Share 4, Parcel G, Petronilla Ranch, Canutillo Colony Ditch Co. Sur. (3½ miles southeast of Driscoll). IP 154.89 BOPD, ⅛-in., 28.8°, GOR 160 cu. ft. per bbl., TP 640 psi., perforations 5,115-19 ft. TD 7,536 ft. (New field.)

Union Oil Co. of California 1 State Tract 447, Corpus Christi Bay. Absolute open-flow potential 31 M.M.c.f.d., GLR 60.7 M.c.f. per bbl., 41.3°, shut-in TP 2,922 psi., perforations 8,036-46 ft. (Frio). TD 8,500 ft. (Second well and new pay in Tri-Channel field.)

The Texas Co. 1-B Jauer, John Luter Sur., A-853 (2½ miles west of Clarkwood). IP 45.93 BOPD, X-37 choke, 22.1°, GOR 182 cu. ft. per bbl., TP 90 psi., perforations 3,100-04 ft. (Miocene-Oakville). TD 4,300 ft.(New pay in Rollins Hills field.)

Polk County: Oil Reserves Corp. 1 Carter-Quinn, A. Morales Survey (3 miles east of Segno). IP 110.86 BOPD, 5/32-in., 35.2°, GOR 800 cu. ft. per bbl., TP 500 psi, perforations 5,207-10 ft. (Yegua.) TD 8,650 ft. (New pay and extension ¾ mile north of Segno field.)

Refugio County: Humble Oil & Refining Co. 1 Shay, J. Power and J. Hewitson Sur., A-54 (6 miles north of Vidauri). Absolute open-flow potential 5,600 M.c.f.d., GLR 113.2 M.c.f. per bbl., 58.4°, shut-in TP 2,154 psi., perforations 5,559-67 ft. (Frio), and (dual completion) 32,000 M.c.f.d., GLR 1,052 M.c.f. per bbl., 43.1°, shut-in pressure 2,047 psi., perforations 5,030-40 ft. (Frio). TD 6,500 ft. (New field.)

San Patricio County: W. J. Riley 1 Raithel, Section 53, George H. Paul Subd., Coleman Fulton Pasture Co. Lands (8 miles east of Odem). Absolute open-flow potential 33,500 M.c.f.d., dry gas, shut-in TP 1,057 psi., perforations 2,454-62 ft. TD 4,210 ft. (New pay in South Taft field.)

D. D. G. Gas & Oil Corp. and Armstrong & Horn et al. 1 Glasscock, Farm Tract 87, San Patricio Hibernia Grant, A-30 (1¼ miles northeast of San Patricio). IP 198.34 BOPD, 5/32-in., 41°, GOR 373 cu. ft. per bbl., TP 840 psi., perforations 6,108-10 ft. (Vicksburg). TD 6,510 ft. (New field.)

Head-Welsh 1 Luling Foundation, Section 50, George H. Paul Subd., Welder Ranch (2 miles north of Edroy). IP 125.02 BOPD, 7/64-in., 40°, GOR 825 cu. ft per bbl., TP 700 psi., perforations 5,843-47 ft. (basal Frio). TD 6,100 ft. (New field.)

Tyler County: Oil Reserves Corp. 2-K Kirby-Slaughter, W. F. Slaughter Sur., A-31 (3 miles southeast of Fred). IP 300.06 BOPD, 5/32-in., 50.8°, GOR 3,838 cu. ft. per bbl., TP 2,500 psi., perforations 8,894-8,907 ft. (Wilcox). TD 10,370 ft. (New field.)

Victoria County: Morgan Exploration Co. 1 Adickes, Eben Haben Sur., A-58, 2¾ miles northeast of Mission Valley). Absolute open-hole potential 4,900 M.c.f.d., dry gas, shut-in TP 816 psi., perforations 1,922-28 ft. (Frio). TD 9,308 ft. (New field.)

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VICE PRESIDENT

July 18, 1958

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Lee Daniel

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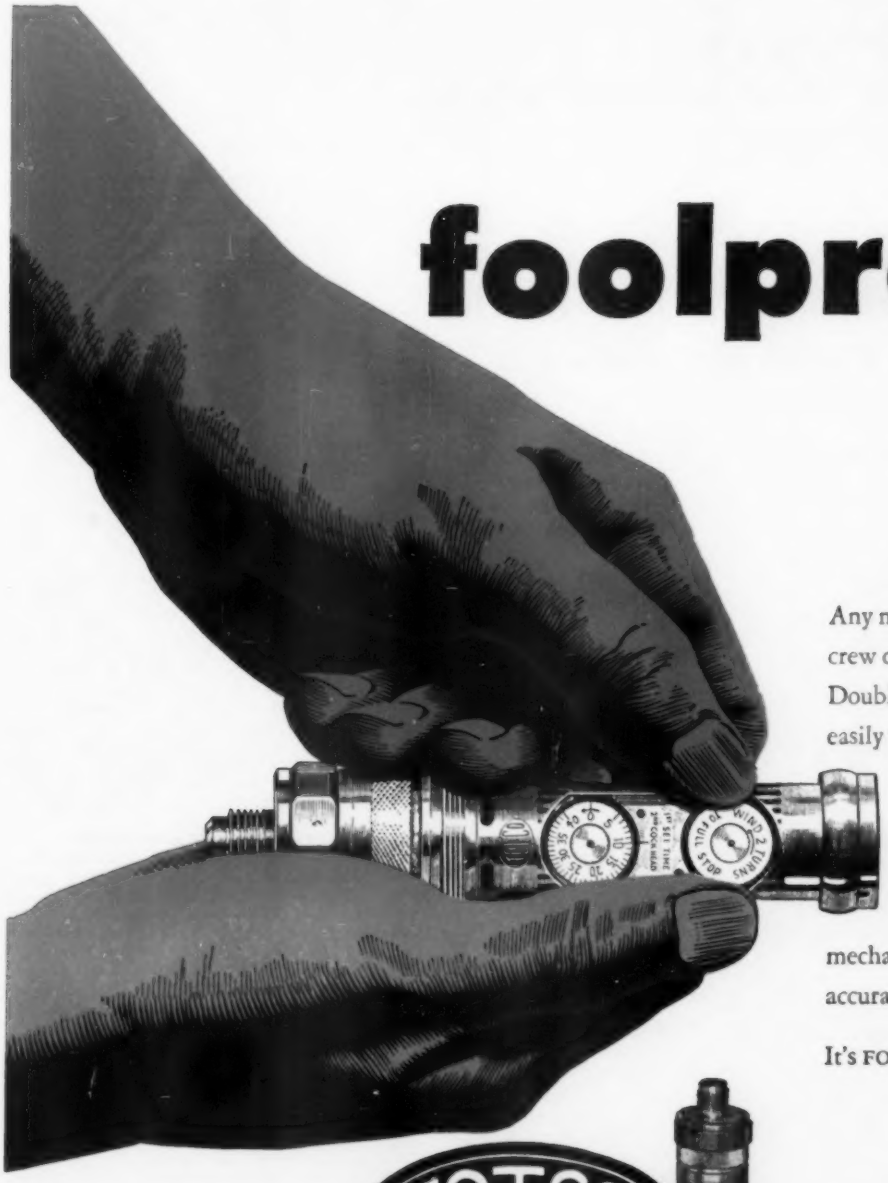

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Sunray Mid-Continent Oil Co. 12 Union Keeran, Martin de Teon Grant, A-47 (9 miles northeast of Placedo). IP 53.86 BOPD (net), 4.5% water, P-28 choke, 30.1°, GOR 870 cu. ft. per bbl., TP 275 psi., perforations 5,875-77 ft. (Frio). TD 8,300 ft. (New pay in Southeast Keeran area.)

SOUTHWEST TEXAS

Atascosa County: R. A. R. Special and Tom Crews 7 Walton, Galba Fuqua Sur. (4 miles south of Jourdanton). IPP 43 BOPD (net), 50% water, 24°, GOR 250 cu. ft. per barrel, perfs. 3,050-52 ft. (Wilcox-Bartosch). TD 3,079 ft. (New pay in Galba field.)

Caldwell County: Sun Oil Co. 2 Blackwell, William Dearduff Sur. (7 miles north of Luling). IP 69.04 BOPD, 3/32-in., 36.7°, TP 190 psi., perfs. 2,364-70 ft. (Edwards). TD 2,374 ft. (New oil discovery in Luling-Branyon area.)

Dimmit County: W. J. Steeger et al. 1 Standifer, Sec. 42, Blk. 1, I&GN Sur. (3 miles west of Big Wells). IPP 70.44 BOPD (net), 10% water, 33.7°, GOR 250 cu. ft. per barrel, perfs. 4,249-56 ft. Navarro-Olmos. TD 5,251 ft. (New field.)

Duval County: Farenthold & Pitcairn 2 Canales, Share 28, Marcelo Hinojosa Grant (7 miles south Realitos). IP 121 BOPD, ⅛-in., 45°, GOR 600 cu. ft. per barrel, TP 750 psi., perfs. 5,106-09 ft. (Pettus). TD 5,111 ft. (New pay in Balderas field.)

Rodney DeLange and O. Neathery, Jr., 1 Blas Garcia, Sec. 76, Rafael Guitierez Sur., A-1014 (7 miles southwest of San Diego). Absolute open-flow potential 21,000 M.c.f. daily, dry gas, TP 1,975 psi., perfs. 5,217-21 ft. TD 5,320 ft. (New field.)

S. H. Howell 1 Richard Rogers, A. C. Holmes Sur. 7, A-299 (8 miles northwest of San Diego). Absolute open-flow potential 4,000 M.c.f. daily, dry gas, shut-in TP 1,339 psi., perfs. 3,171-77 ft. (Frio). TD 4,080 ft. (New gas discovery in Blanchard area.)

Hidalgo County: Phillips Petroleum Co. 6-A Bentsen, Sec. 23, Los Guages Grant (15 miles north of Sullivan City). IP 125.73 BOPD, ⅛-in., 46.3°, GOR 692 cu. ft. per barrel, TP 725 psi., perfs. 5,502-07 ft. (Frio-Royal sand), and 6,500 M.c.f. daily, absolute open-flow potential, dry gas, shut-in TP 1,779 psi., perfs. 4,772-79 ft. (Frio-Flores sand). TD 5,662 ft. (New dual discovery in Javelina area.)

Hidalgo County: Shell Oil Co. 4 Boston Texas Land Trust Co., Section 22, Los Guages Grant, A-83 (2 miles west of McCook). Absolute open-flow potential 9,200 M.c.f.d., GLR 17.4 M.c.f. per bbl., 54.4°, shut-in. TP 6,315 psi., perforations 11,281-88 ft., 11,308-10 ft., 11,332-64 ft., 11,383-11,404 ft., and 11,413-19 ft. (lower Vicksburg). TD 13,370 ft. (New pay in Javelina field.)

V. F. Neuhaus 1 Bray Unit, Tract 204, Section 181, West Tract Subd., Llano Grande Grant (2¾ miles northwest of Weslaco). Absolute open-flow potenial 5,500 M.c.f.d., GLR 106-4 M.c.f. per bbl., 54.2°, shut-in TP 3,527 psi., perforations 8,541-56 ft. (Frio). TD 10,-101 ft. (New pay in North Weslaco field.)

Northern Pump Co. 1 Thompson, Tract 202, Block 180, West Tract Subd. (3½ miles north of Weslaco). Absolute open-flow potential 10,700 M.c.f.d., GLR 70 M.c.f. per bbl., 58°, shut-in TP 3,769 psi., perforations 8,614-22 ft. (Frio). TD 9,850 ft. (New pay in North Weslaco field.)

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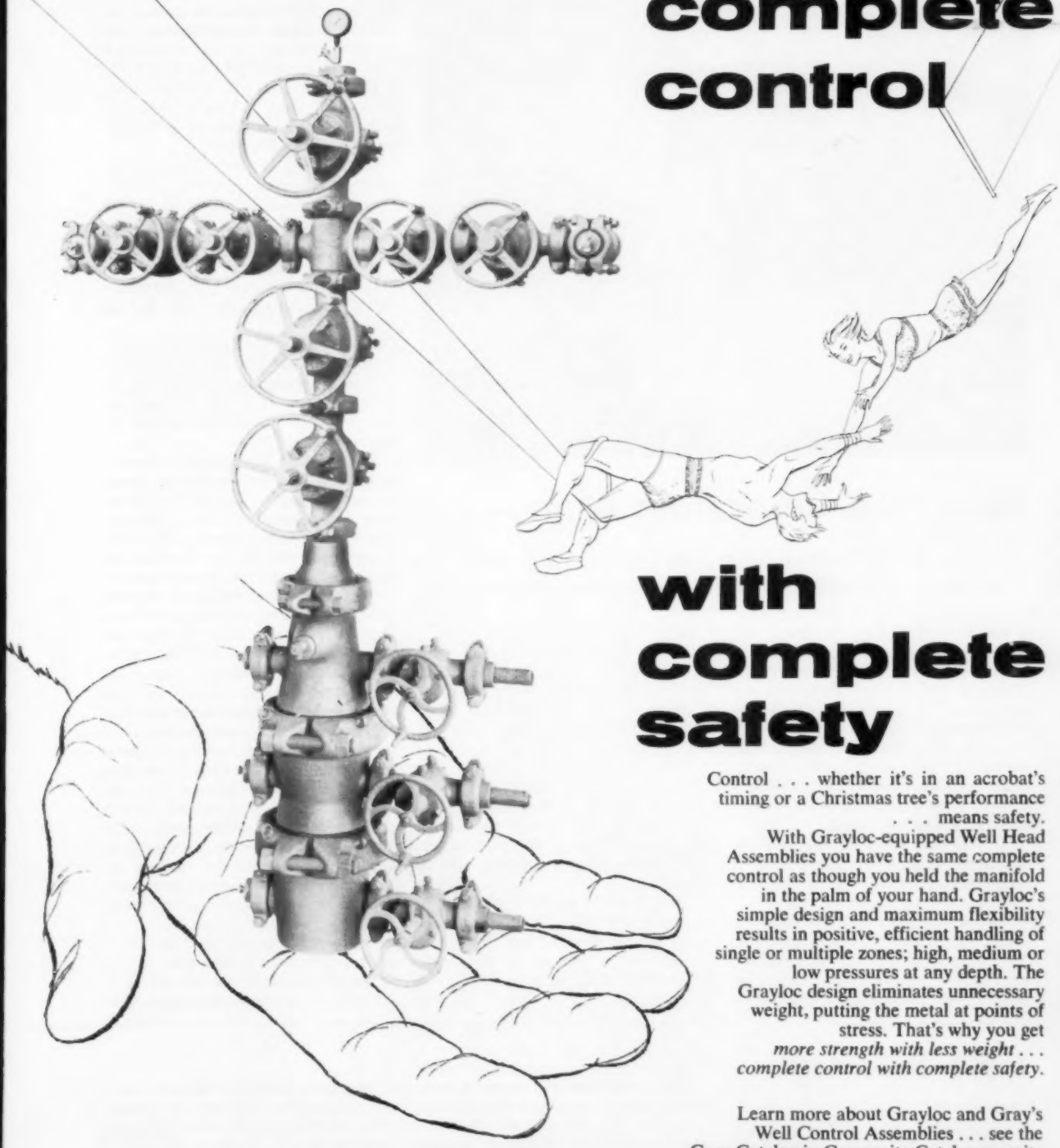

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New Top Operating Man

. . . for D. D. Feldman is Fred Sharp, who helps carry out company's unusual production-exploration policies.

LAST WEEK Fred O. Sharp, Jr., officially moved up from executive assistant and coordinator with D. D. Feldman Oil & Gas, Dallas, to the company's top operating post as general manager.

At the same time, he assumed the executive vice presidency of Worldwide Petroleum Corp., Ltd., a holding company for the several Feldman subsidiaries operating abroad.

In this dual position, Sharp will be directing what is probably one of today's most unusual independent operations.

Roughly 2 years ago, Feldman decided to abandon as unprofitable the conventional independent mode of operation in this country—exploring, drilling, and producing. The company reasoned that costs of developing a barrel of oil in the U. S. had risen so high that in many instances they exceeded its worth in the ground.

The new plan of operation called for: (1) Deemphasizing exploration in this country; (2) using this money to develop production in foreign countries where finding costs were lower and the market in better shape; (3) concentrating on buying production and water flooding in this country, while continuing to produce existing properties.

Sharp's was a major voice in influencing this decision. And since it was made he has played a key role in implementing it. He set up Feldman's exploration office in Calgary in 1956 and managed it from Dallas. He was a prime negotiator in Germany earlier this year in the talks with Wintershall, A. G., which culminated in the recent joint Canadian exploration deal between Feldman and the Wintershall subsidiary, Ceepee Oil Co., Ltd.

He negotiated the contract with Gulf Oil Corp. whereby Feldman farmed out its concessions in Turkey on advantageous terms.

He has had a hand in nearly all recent production purchases, waterflood decisions, and negotiations for foreign concessions.

Producer or refiner? . . . Sharp, still only 38, has 16 years of unusually varied engineering experience behind him.

Undecided at first as to which way to go in the oil business, he majored in both petroleum production and refining while working for his B.S. degree at Tulsa University's school of engineering.

For a while it appeared almost a sure thing that the processing career would win out. During his senior year, he was one of a dozen promising engineering students over the country selected by the Institute of Gas Technology for 4-year scholarships to work for doctorate degrees. Sharp's sponsoring company was Dresser Industries, Inc., for whom he was pledged to work between terms.

During the first summer, Sharp and two other institute students made a detailed study for Dresser of the market, engineering, economics, and transport feasibilities of liquefying natural gas and moving it by barge to the East Coast. Impressed, Dresser officials, on completion of this project, offered the students permanent jobs, under which they would leave school and do further low-temperature work in developing oxygen-generating equipment for the Army and Navy. They accepted.

When this project, too, was completed, Sharp made the first of two major decisions. He decided he wanted to be in the producing rather than

▶ ▶ ▶ Personals

Rodney W. Jackson, geophysicist, has been transferred to Oklahoma City from Worland, Wyo., by Carter Oil Co.

Bill Hoover, geologist in Wichita Falls, Tex., for Humble Oil & Refining Co., has taken early retirement. He will become an independent operator in Amarillo, Tex.

J. J. Thuis has been named Casper, Wyo., district geologist for Phillips Petroleum Co. He succeeds **Robert J. Haas,** recently transferred to Bartlesville, Okla.

Arthur J. Palmer has been promoted to engineering associate by Esso Research & Engineering Co. Palmer, formerly in the design engineering division at Linden, N. J., has been given a 1-year assignment in The Hague, Netherlands.

Mortimer Squires, assistant general superintendent of drilling and production for Natural Gas & Oil Co., has resigned to join Rodgers, Seglund & Shaw Associates, New Orleans consulting firm.

L. E. Lorensen, chemist in the fuels and engine-lubricants department at Shell Oil Co.'s Emeryville, Calif., research center, has been given a 2-year assignment in Shell's manufacturing-research department in New York.

the processing side of the business. He contacted Atlantic Refining Co. and went to work for that firm as a production engineer at Odessa, Tex.

Experience in a hurry . . . Short-handed due to the war, Atlantic got lots of mileage from the few engineers it had. At one time, Sharp says, "we had a dozen rigs going in the district to depths below 14,000 ft. with a supervisory force of just three engineers and a couple of production men. Experience came thick and fast."

In late 1946, Sharp joined Carter Oil Co. as a senior engineer at Carmi, Ill., and began to move up. He was named district engineer in 1948 when Carter was just beginning to test out water flooding in that area. Sharp engineered these first floods. Between 1948 and 1952, the number of engineers working for him increased from 2 to 10.

A gamble . . . In 1952, he made his second big decision—to leave his relative security and assured career with a major (Carter) to gamble for bigger things with an independent operator. He started looking and joined Feldman in late 1952 as district supervisor (district production superintendent) in California at Los Angeles.

His work there was quickly recognized by Feldman and he was promoted to executive assistant and coordinator at Dallas in December 1953.

Sharp feels strongly that an independent operator has to adapt to the times—and that now is a time when it isn't financially wise for him to try to explore solely in the U. S. It is better, he feels, to look for oil not only where it is cheaper and easier to find but also where the oil found is assured a market. This explains, for instance, the company's current intensive search to develop production in oil-starved France.

If conditions at home should improve substantially, he says, then Feldman exploration emphasis might be shifted back to the U. S.

L. P. Hellen, staff geologist for Carter Oil Co., has been transferred to Oklahoma City from Ponca City, Okla.

Paul P. Powell has been named district production superintendent for Apache Oil Corp.'s Oklahoma and Texas Panhandle areas. A graduate of the University of Tulsa, Powell was formerly a petroleum engineer with Cities Service Oil Co., Midstates Oil Corp., and Lion Oil Co.

Tom R. Shugart, manager of exploration, and **Lee Conroe,** manager of the land and lease department, D. D. Feldman Oil & Gas, have been named vice presidents of Worldwide

SHUGART

CONROE

SMOOT

Petroleum Corp., Ltd., a holding company directing operations of all Feldman firms operating abroad. **Harold N. Smoot,** formerly assistant manager of the land and exploration department for Feldman Oil & Gas, has been promoted to executive assistant and coordinator at the Dallas headquarters. Smoot replaces **Fred O. Sharp, Jr.,** now general manager (see p. 318). **R. H. Angevine,** formerly Oklahoma district production superintendent at Ada, has been named to a new job as superintendent of water-flood operations at Dallas in a reorganization which splits the former production department into water flood and primary-production departments. Still primary-production superintendent, but with added responsibility, is **J. L. Lee. Loy M. Hembree** moves up from district engineer at Ada to succeed Angevine there. **Jim Miller,** staff engineer at Ada, will replace Hembree. And **Jim Lightfoot,** formerly engineer at Monahans, Tex., will move to Ada to replace Miller.

Eugene F. Sullivan, former group supervisor at California Research Corp.'s Richmond, Calif., laboratory, has been appointed supervising research engineer. He will be responsible for technical service to the chemical plants in the Richmond refinery of Standard Oil Co. of California.

Bob Winkler, formerly geologist with Seabord Oil Co., has joined Aikman Oil & Gas Co., Amarillo, Tex.

C. Warren Fatheree has resigned as geologist for the Cree companies in Pampa, Tex., to open consulting offices there. Fatheree was with Cabot Carbon Co. before joining Cree.

▶ ▶ ▶ Personals

Marvin L. (Pete) Ralston has been named director of the costs and economics department for Gulf Oil Corp. at Port Arthur, Tex. He succeeds **Z. Q. Johnson,** who has been transferred to Gulf headquarters in Pittsburgh.

E. E. Wasson, chief station engineer at Interstate Oil Pipe Line Co.'s Finney station, near Shreveport, La., has retired. Wasson joined Standard Oil Co. of Louisiana, predecessor of Interstate, in 1913. He became first chief engineer at the Finney station in 1954.

Dr. E. R. Brownscombe has been named senior research associate in Atlantic Refining Co.'s crude-oil production division at Dallas. **Dr. R. G. Simard** has been named research associate in the basic research division at Philadelphia. Atlantic recently created the research-associate post as a non-administrative ladder of promotion for scientists and engineers. Brownscombe and Simard are the first to receive the title.

P. A. Cole, assistant chief geologist for Cities Service Gas Co., has moved up to chief geologist. He succeeds **Charles C. Hoffman,** who recently retired. **Robert T. Gaut,** storage superintendent at McLouth, Kans., has been named superintendent of gas storage in the Oklahoma City office. In other changes, **John Inge,** superintendent of the Edmond, Okla., station, has been put in charge of construction of a new station at Independence, Kans. **Glenn Campbell,** superintendent of the Ulysses, Kans., station, will succeed Inge at Edmond. **Larkin Kyle,** engineer at the Hugoton, Kans., station, moves to Ulysses to succeed Campbell. **Harold Moore,** superintendent of the station at Greensburg, Kans., will supervise the Joplin, Mo., and Welch, Okla., stations. He replaces **F. T. McAdam,** who has retired. **James Dancer,** engineer in the Wichita compressor department, will succeed Moore at Greensburg. In Knob Noster, Mo., **E. S. Hanson,** foreman of pipeline division 16 in Wichita, has succeeded **Harry McDaniel** as superintendent. McDaniel has retired. **Leon Burns,** formerly storage foreman, has been promoted to storage superintendent in Petrolia, Kans. Also, **Leonard Dowdy** has been named station foreman in Welda, Kans. He succeeds **Robert Ecclefield,** who has retired. **Albert Blanchard** has been named station foreman in Corwin, Kans., succeeding **C. Z. Parker,** who has retired.

▶ ▶ ▶ Personals

R. A. Hunter has been elected administrative vice president, marketing department, for Gulf Oil Corp. He will continue as coordinator for all marketing and will be chairman of Gulf's marketing council. Hunter joined Gulf in 1933. He was general manager of retail and jobber sales before being named coordinator of marketing. Hunter has also served with the Petroleum Administration for War and Petroleum Administration for Defense in 1942, 1945, and 1951.

Bill Kelley, geologist with Champlin Oil & Refining Co., has been transferred from Abilene, Tex., to Oklahoma City as area geologist.

Raymond E. Johnson, driller with Standard Oil Co. of California in Centralia, Wash., has been transferred to Seattle, as technical assistant.

E. G. Warren, Jr., has been promoted to senior electrical engineer in the technical division at Humble Oil & Refining Co.'s Baytown, Tex., refinery.

M. L. Reed, Shell Oil Co.'s Kilgore, Tex., division exploitation engineer, has been transferred to Houston as senior exploitation engineer. **V. B. Porter,** division reservoir engineer in Kilgore, has moved to Houston as exploitation engineer. **O. J. Shirley,** exploitation engineer in Houston, has been transferred to the New Orleans area. **W. L. Stevenson,** Houston exploitation engineer, has moved to Quitman, Tex., in the same capacity.

Greer W. Orton, manager of The Texas Co. (Iran), Ltd., in London, has been named assistant to the chairman of The Texas Co. **H. H. Chandler,** assistant manager of Texaco (Iran), moves up to manager succeeding Orton. Orton joined Texaco in 1928. He has served as manager of the purchasing department, general manager of foreign operations, and a director of various foreign affiliates. He was executive assistant in New York before being named senior representative in London in 1954. Chandler has been with the company since 1932. He was superintendent of the Eagle Point works, Westville, N. J., before assignment to London last year.

J. A. Behrens, assistant superintendent at Shell Oil Co.'s Provident City natural-gasoline plant, Sheridan, Tex., has been promoted to plant superintendent.

Herbert W. Wagner has retired as chief chemist of United Refining Co. He had been with the company since 1922.

R. J. Mickey and **Frank C. White,** geologists with Phillips Petroleum Co., have been transferred to Oklahoma City from Ardmore, Okla.

F. A. Lawrence, Cities Service Oil Co.'s East Texas production division superintendent in Gladewater, Tex., has retired. Lawrence joined Cities Service in 1919. He had been division superintendent in Gladewater since 1936. **F. D. Priebe** will take over responsibility for the East Texas district in addition to his duties as Gulf Coast division superintendent. **H. E. Massey,** district superintendent, will be in charge of the company's Gladewater office.

James A. Gillham, formerly with Warren Petroleum Corp., has joined **William H. Pine,** Okmulgee, Okla., independent operator, as general production superintendent. **Dan C. McClung,** formerly with Crown Central Petroleum Corp., has joined Pine as exploration manager. Also, **C. P. Van Hoose,** formerly with Ball Brothers Glass Co., becomes head of the accounting department. All will headquarter in Okmulgee.

Don E. Kennedy has been named a section leader in the research and development department of the Standard Oil Co. (Ind.) Seymour, Ind., laboratories. Kennedy has been with Indiana Standard since 1954, working mainly with solid propellant research. At the company's Whiting, Ind., research laboratories, **Francis E. Porsche** has been named senior project chemist and **Edwin F. Morello** and **Bruce A. Ritzenthaler** have been appointed group leaders.

W. R. Cox, Jr., mechanical engineer for Shell Oil Co. in Corpus Christi, Tex., has been promoted to district mechanical engineer and transferred to Kilgore, Tex. **F. H. Culver,** mechanical engineer in Houston, and **J. W. Montgomery,** mechanical engineer in the Midland, Tex., area, have been transferred to Corpus Christi. **E. W. Wallace,** Houston mechanical engineer, has moved to the Pacific Coast area. **J. V. Vogel,** mechanical engineer in Kilgore, has been named development engineer in Houston.

Harry W. Bass, Dallas independent, and **L. F. McCollum,** president of Continental Oil Co., will receive distinguished service awards at the Texas Mid-Continent Oil and Gas Association's annual meeting this week in Dallas. The awards are given each year to an independent producer and

BASS

McCOLLUM

a major company executive for service to the industry. Bass is a former president of the association. He is president of H. W. Bass & Sons, president of Can-Tex Drilling Co., and chairman of Goliad Corp. He has been active in the industry since 1919. For many years he headed Harry Bass Drilling Co., which was sold earlier this year. McCollum was coordinator of production activities for Standard Oil Co. (N. J.) before becoming president of Continental in 1947. He was president of Carter Oil Co., Jersey subsidiary, at one time.

Col. Douglas R. Brown, U. S. Air Force petroleum director, at Middletown, Pa., Air Materiel Command, has joined Eastern States Petroleum & Chemical Corp. as assistant to the president. **Col. Wilson A. Chapman,** director of quality control, Air Materiel Command, at Wright Patterson Air Force Base, Dayton, Ohio, will succeed Brown at Middletown. Brown was executive director of Armed Services Petroleum Purchasing Agency, now the Military Petroleum Supply Agency, before assignment at Middletown in 1953.

Theodore R. Goebel, vice president in charge of Columbian Carbon Co.'s Mid-Continent oil and gas division in Houston and a director of the company, has been elected executive vice president. He will continue as a director. **George P. Bunn, Jr.,** Houston, will succeed Goebel as general manager of the Mid-Continent oil and gas division. **O. W. Van Petten,** vice president in charge of the Appalachian oil and gas division in Charleston, W. Va., has resigned after 26 years with the company. He will continue as a director and a consultant to the company. **R. B. Anderson,** Charleston, has been named general manager of the Appalachian division, succeeding Van Petten.

B. H. Wierick, Jr., has been transferred by American Petrofina, Inc., from Denver to Lafayette, La., where he will be district geologist.

Philip M. Cordell, Jr., coordinator and economist for Texas Gas Corp. since 1956, has been appointed manager of the company's new crude-oil supply department.

Dr. David Pandres, Jr., and **Dr. Hendrik K. Van Poolien,** research scientists, have joined Ohio Oil Co.'s Littleton, Colo., research center staff. Pandres was formerly with Chance Vought Aircraft Co., Dallas, and Brown & Root, Inc. Van Poollen was formerly with Standard Vacuum and Halliburton Oil Well Cementing Co.

Paul L. Lyons, chief geophysicist for Sinclair Oil & Gas Co., has been nominated for president of American Geological Institute. He will succeed **J. V. Howell,** Tulsa independent, after the AGI annual meeting next month. **Dr. William W. Rubey,** research geologist with United States Geological Survey, Washington, D. C., has been nominated for vice president. **Donald H. Dow,** also with USGS in Washington, has been renominated for secretary - treasurer. Lyons, a past president of Society of Exploration Geophysicists, has served as AGI vice president this year.

Merle Becker, formerly general manager of D. D. Feldman Oil & Gas at Dallas, has resigned to help set up Becker, Davis & Pyle, Inc., Dallas, a new company to acquire producing properties. Associated with Becker are **Foster M. Pyle,** former production manager for Feldman, and **William H. Davis,** former head of secondary - recovery operations for that company. Prime aim of the new firm will be to acquire oil properties for secondary - recovery operations. But it will also engage in special drilling deals.

Russell B. Brown, general counsel for Independent Petroleum Association of America and head of the association's Washington office, will retire December 31, 1959. Brown joined IPAA in late 1929, supposedly on a temporary basis. He was executive manager for a short time before being named general counsel. Brown has been with IPAA continuously except for a brief stint as compliance director for the planning and coordination committee under the NRA Petroleum Code in the early days of the New Deal. A graduate of the University of Chicago school of law, he practiced law in Ardmore, Okla., before joining IPAA.

W. Joseph Straus, economist and a director of American Securities Corp., and Texas Butadiene & Chemical Corp., has been elected a director of Britalta Petroleums, Ltd., Calgary.

William F. Thiede, an assistant general manager of manufacturing for Esso Standard Oil Co., retired October 1. Thiede joined Esso in 1912 at Linden, N. J., as "No. 1 broom." He later was assistant general superintendent of the Bayway refinery, Linden; general superintendent of the Bayonne, N. J., refinery; manager of the company's old Jersey works, which included the Bayonne and Bayway refineries; and general manager of East Coast manufacturing.

Don B. Wines has been named district exploration manager in Wichita by Tennessee Gas Transmission Co. He succeeds **Don Hellar,** who recently became Wichita Falls, Tex., district exploration manager. **Mark Richardson** and **John Weldon,** formerly in the Oklahoma City office, have been transferred to Wichita as geologists. **Don Brown,** geologist, has been transferred to Casper, Wyo., from Wichita.

▶ ▶ ▶ Personals

W. H. Chatham, chief engineer at Sinclair Pipe Line Co.'s Pontiac, Ill., station, retired October 1. Chatham had been with the company since 1915.

Robert M. Becker, geologist with Walter Duncan Oil Properties, Oklahoma City, since 1955, has opened consulting offices in Oklahoma City.

G. B. Bennett has been named vice president in charge of sales and operations for Houston Corp. distribution properties. He will also be vice president in charge of sales for Houston Texas Gas & Oil Corp. Bennett was formerly with Sun Oil Co. in the production and processing departments.

A. E. Johnson, Pratt, Kans., area superintendent for Sunray Mid-Continent Oil Co., has been named superintendent of the company's new Perryton, Tex., area office. **B. F. Brawley,** production engineer at Oklahoma City, has been transferred to Perryton as area engineer. **W. S. Cable,** lease foreman at Hobbs, N. M., has been named lease foreman at Laverne, Okla. The Perryton office will handle drilling and production operations in the Oklahoma and Texas panhandles and southwestern Kansas. As a result of these changes, **C. C. Brunton,** superintendent of Sunray's Dora Roberts area, Forsan, Tex., will move to replace Johnson as area superintendent. The Dora Roberts area will be absorbed into the Big Spring, Tex., area. **T. W. Tims,** Big Spring area superintendent, will move his office to Big Spring from Odessa, Tex. **J. I. Ginnings,** production engineer in Midland, Tex., becomes area engineer in Big Spring. Also, **D. J. Van Orden,** production engineer in Midland, will move to Odessa as area engineer. **O. T. Owen,** lease foreman in Farmington, N. M., has been named to replace Cable at Hobbs.

▶ ▶ ▶ Deaths

Ralph Allen (Jack) Brant, 59, Tulsa regional research geologist for Atlantic Refining Co., died September 30 in a Tulsa hospital. He had been with Atlantic since 1929. A graduate of the University of Chicago, Brant was the first to receive a master's degree in geology from the University of Tulsa in 1942. He was a past president of the Tulsa Geological Society.

Thomas E. Ronan, 60, retired manager of sales administration for Ethyl Corp., died September 24 at his home in Larchmont, N.Y. Ronan was Tulsa division manager for Ethyl at one time. He retired in 1956.

Joseph Gardenhire, 51, Farmington, N.M., manager for Rocky Mountain Cementers, died recently after a brief illness. Gardenhire was with Anschutz Drilling Co. at Casper, Wyo., for 12 years before moving to Farmington last year.

Lloyd F. Bayer, 64, senior vice president and a director of Tidewater Oil Co., died September 29 in Oakland, Calif., of a blood ailment. Bayer joined Tidewater in 1916. He was named a vice president in 1927, a director in 1929, and became senior vice president in 1954. He was also a director of Mission Development Co.

▶ ▶ ▶ Statistical Section

Crude stocks hit bottom

. . . after postwar record drop of 45,000,000 bbl.

BY JOHN C. CASPER

CRUDE STOCKS may increase slightly in October despite the announced cuts in production allowables.

The crude stock picture has been highlighted by sharp changes for the past 2 years. There was a sharp drop during the Suez crisis, followed by a rapid rise. Inventories reached a postwar peak in July last year with a reported total of 288,241,000 bbl.

Minor reductions came in July and August. A gain of 4,000,000 bbl. in October was followed by a good reduction in November. There was little change in December, but further gains in January and February created a situation that called for a reduction. The peak demand season was over. Gasoline stocks were high. The oversupply forced drastic cuts in production.

These production cuts were severe enough to lower crude stocks from 285,000,000 bbl. at the end of February to about 240,000,000 bbl. at the end of August. This was the lowest stock level since 1951.

Actual crude stock reductions for central and eastern areas have been more severe than indicated by the national totals. Recent reports have shown total crude stocks for the country as a whole to be down a little over 40,000,000 bbl. However, the totals include increases on the West Coast amounting to a little over 4,000,000 bbl. For the rest of the country, total crude is down almost 45,000,000 bbl. from last year.

Here's the probable crude line up for October. Announced cuts in production allowables will bring total crude production for the month down to about 6,870,000 bbl. daily. Crude imports will average near 950,000 bbl. daily for a total new supply of 7,820,000 bbl. daily.

October refinery runs normally drop slightly below the September average. In the postwar period, October runs have averaged 1.5% less than September. However, the drop may be less this year since refinery runs have been restricted for most of the year. Monthly averages have been below 8,000,000 bbl. daily every month since August last year.

Refinery runs probably will average about 7,670,000 bbl. daily in October for a small decrease from September. Exports, transfers, and losses will account for an additional 100,000 bbl. daily for a total crude demand of 7,770,000 bbl. daily.

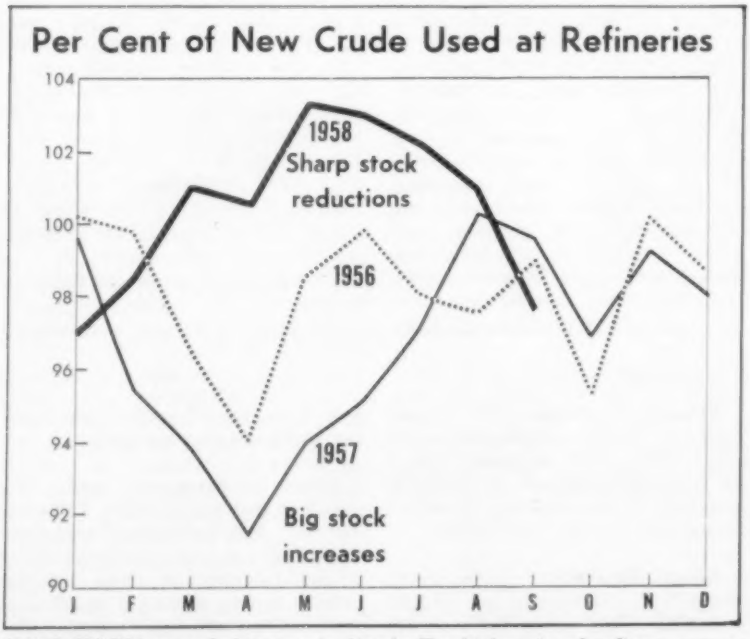
With crude supply averaging 7,820,000 bbl. daily, demand at 7,770,000 bbl. daily will leave about 50,000 bbl. daily for small additions to storage. That rate would add about a million and a half barrels to crude inventories during the month.

The chart shows how the crude supply-demand pattern for 1958 differs from past performance. The lines picture the ratio of refinery runs to new crude supply. Over a long period of time, the average will be under 100% since some crude is exported, lost through evaporation, or used directly as fuel.

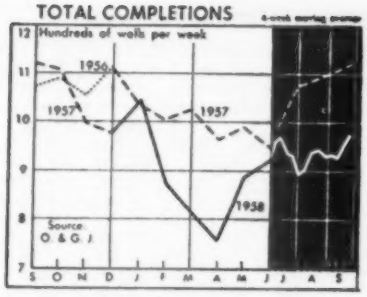
Note that runs exceeded new crude supply from March through August this year.

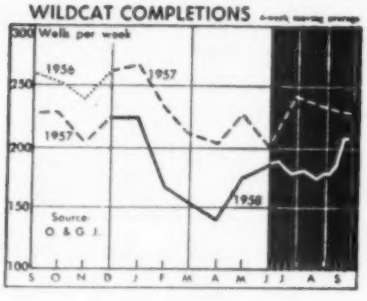
A quick look at the highlights . . .

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	7,099,400	DOWN	6,025	UP	206,104
Crude stocks	242,584,000	UP	1,868,000	DOWN	40,581,000
Completions	940	DOWN	123	DOWN	207
Refinery runs	7,639,000	UP	35,000	DOWN	279,000
Gasoline stocks	173,481,000	UP	323,000	DOWN	3,949,000
Kerosine stocks	30,942,000	UP	931,000	DOWN	5,389,000
Distillate stocks	153,633,000	UP	4,172,000	DOWN	15,632,000
Residual stocks	69,595,000	UP	702,000	UP	11,879,000
Four-product stocks	427,651,000	UP	6,128,000	DOWN	13,091,000
Total imports	1,926,800	UP	466,500	UP	569,200



CRUDE STOCKS started dropping in March. The high ratio of refinery runs to new crude supply produced a continuous stock decline through August.





Active Rotary Rigs*

	9-29-58	9-22-58	9-30-57
Alabama	7	6	2
Arkansas	25	25	27
Arizona	2	2	1
California	73	75	98
Colorado	41	38	63
Florida	1	1	1
Georgia			
Idaho			
Illinois	51	53	63
Indiana	10	8	6
Iowa	3	3	2
Kansas	142	147	151
Kentucky	4	10	8
Louisiana	299	311	427
North	27	35	61
South	235	238	276
Offshore	37	38	90
Maryland			1
Michigan	10	12	8
Missouri	1	1	
Montana	23	20	33
Mississippi	51	45	42
Nebraska	21	26	36
Nevada			
New Mexico	92	100	148
New York	2	2	
North Dakota	32	34	40
Ohio		1	
Oklahoma	212	209	253
Oregon			1
Pennsylvania	9	9	14
South Dakota	3	3	2
Texas	670	669	852
South-Gulf	135	129	181
Offshore	1	1	2
North-East	167	171	(†)
West Central	212	210	(†)
West	155	158	(†)
Tennessee			1
Utah	31	29	68
Washington	1	1	1
West Virginia	2	3	2
Wyoming	63	66	82
Virginia			
Total U. S.	**1,881**	1,909	2,433
Western Canada	137	146	194
Eastern Canada	4	4	3
Grand total	2,022	2,059	2,630

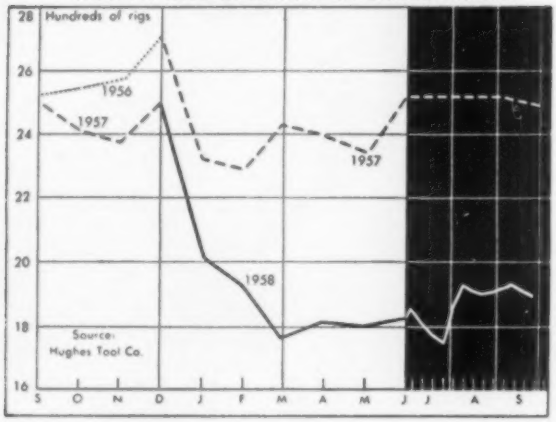
*Hughes Tool Co. †Comparisons not available due to change in method of reporting.

WEEKLY WELL COMPLETIONS . . . WEEK ENDED SEPTEMBER 27, 1958

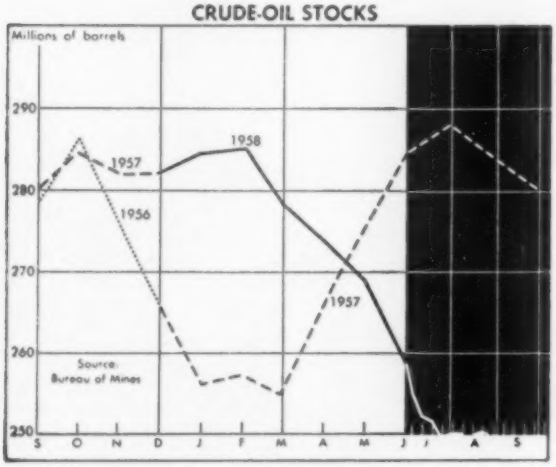
	Total wells							Cumulative		Total wildcats					Cumulative	
	Total	Crude	Cond.	Gas	Dry	Service	Footage	1958	1957	Total	Crude	Cond.	Gas	Dry	1958	1957
Alabama	3	0	0	0	3	0	3,665	58	65	3	0	0	0	3	23	20
Arkansas	22	10	1	2	9	0	80,590	571	826	5	0	1	1	3	121	149
California	13	8	0	0	5	0	78,850	1,160	1,623	4	1	0	0	3	278	394
Colorado	19	4	0	1	14	0	96,203	606	629	10	0	0	0	10	350	417
Illinois	59	23	0	0	36	0	144,635	1,643	1,940	11	1	0	0	10	332	479
Indiana	28	9	0	0	19	0	39,627	578	480	10	1	0	0	9	206	93
Kansas	87	32	0	10	42	3	304,937	2,785	3,117	16	0	0	0	16	587	628
Kentucky	25	8	0	3	14	0	37,412	868	1,093	5	0	0	0	5	114	225
Louisiana	74	22	9	9	34	0	501,583	2,546	2,838	15	1	0	2	12	374	504
North	41	13	0	9	19	0	168,176	946	1,013	9	1	0	2	6	158	133
South	28	7	9	0	12	0	279,222	1,274	1,311	5	0	0	0	5	193	307
Offshore	5	2	0	0	3	0	54,185	326	514	1	0	0	0	1	23	64
Michigan	6	3	0	0	3	0	15,522	304	316	2	0	0	0	2	99	112
Mississippi	9	1	0	0	8	0	82,533	286	293	7	0	0	0	7	133	153
Montana	4	2	0	0	2	0	21,372	249	305	2	0	0	0	2	101	119
Nebraska	13	6	0	0	7	0	80,937	517	655	6	0	0	0	6	243	362
New Mexico	28	20	0	5	3	0	125,246	1,439	1,588	2	0	0	0	2	196	208
West	10	4	0	5	1	0	43,190	694	647	1	0	0	0	1	82	78
East	18	16	0	0	2	0	82,056	745	941	1	0	0	0	1	114	130
New York	8	3	0	0	0	5	11,286	409	344	0	0	0	0	0	37	6
North Dakota	3	2	0	0	1	0	16,853	335	199	1	0	0	0	1	109	91
Ohio	15	3	0	2	6	4	33,771	757	829	0	0	0	0	0	12	10
Oklahoma	143	73	3	6	49	12	462,538	4,747	4,668	23	5	0	1	17	653	546
Pennsylvania	0	0	0	0	0	0	0	438	486	0	0	0	0	0	14	39
Texas	346	199	10	6	125	6	1,446,718	13,276	16,277	69	4	2	1	62	2,729	3,909
Dist. 1	22	11	2	0	9	0	74,447	726	932	6	1	0	0	5	290	317
Dist. 2	13	3	0	0	10	0	94,077	560	572	4	0	0	0	4	149	206
Dist. 3	18	6	3	0	9	0	142,462	950	1,284	4	0	0	0	4	215	365
Dist. 4	11	1	1	0	9	0	74,725	875	1,063	4	0	1	0	3	261	353
East	42	21	3	0	18	0	185,816	921	994	11	0	0	0	11	256	286
Dist. 7-B	53	23	0	0	29	1	128,080	1,810	2,162	14	2	0	0	12	510	746
West	103	80	1	1	20	1	481,997	3,810	4,609	15	1	1	0	13	538	658
Dist. 9	59	36	0	3	16	4	172,345	2,668	3,584	8	0	0	1	7	430	897
Dist. 10	25	18	0	2	5	0	92,769	956	1,077	3	0	0	0	3	80	81
Utah	4	1	0	0	3	0	23,789	283	160	3	0	0	0	3	64	82
West Virginia	20	1	0	13	6	0	57,856	535	501	1	0	0	1	0	13	23
Wyoming	10	5	0	1	4	0	63,607	558	622	1	0	0	0	1	165	214
Misc. (Ariz.)	1	0	0	0	1	0	1,820	70	109	1	0	0	0	1	60	92
Total U. S.	**940**	435	23	58	394	30	3,731,350	35,018	39,963	**197**	13	3	6	175	7,013	8,875
Total Prev. Wk.	1,063	498	23	80	423	39	4,080,435			249	33	5	4	207		
Cum. 1958	35,018	17,119	852	2,667	13,460	920	144,780,831			7,013	684	121	201	6,007		
Western Canada	54	31	0	5	15	3	265,349	1,811	2,282	18	2	0	4	12	493	642

PRODUCTION

ROTARY RIGS OPERATING IN UNITED STATES



CRUDE-OIL STOCKS



CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

	9-20-58	9-13-58	9-21-57
Pennsylvania	2,842	2,853	3,213
Other Appalachian	1,432	1,379	1,759
Illinois, Indiana, Michigan	10,253	10,098	11,663
Nebraska and North Dakota	2,411	2,230	2,835
Kansas	9,171	9,289	10,572
Oklahoma	15,408	15,821	22,072
Arkansas	1,785	1,872	2,673
Louisiana	15,808	15,001	19,462
North	2,722	2,722	3,246
South	13,086	12,279	16,216
Mississippi, Alabama, Florida	2,635	2,765	2,894
New Mexico	7,987	8,005	10,304
Texas	103,344	100,686	126,995
East Texas	7,603	7,668	9,980
West Texas	50,953	49,982	60,508
Texas Gulf	18,889	17,988	24,376
Other Texas	25,899	25,048	32,131
Wyoming	13,108	13,104	15,861
Other Rocky Mountain	9,147	9,127	6,045
California	34,490	35,047	31,042
Foreign	†12,763	13,439	15,775
Total	**242,584**	240,716	283,165

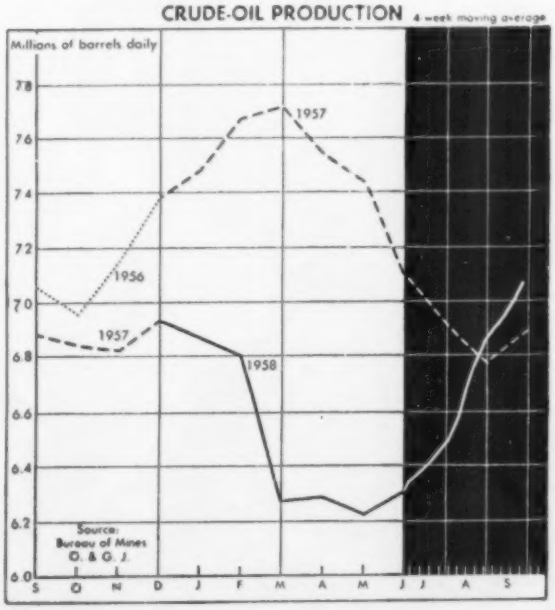
*Bureau of Mines. †Includes 4,802,000 bbl. in California.

DAILY AVERAGE PRODUCTION FOR WEEK

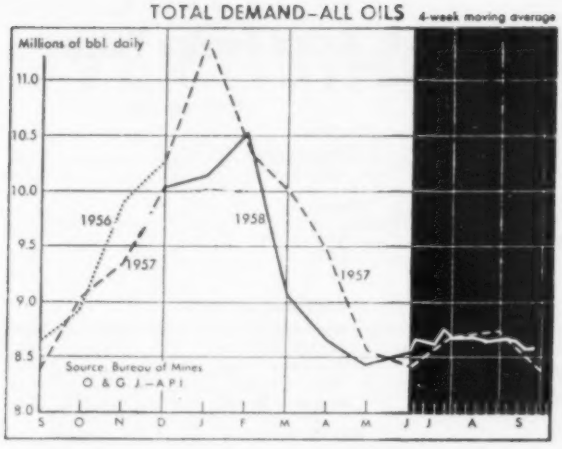
	September 27, 1958			Sept. 20
	Crude oil	Lease condensate	Total	total
Alabama	14,950		14,950	15,000
Arkansas	73,420	180	73,600	73,750
California	852,600		852,600	851,800
Colorado	131,300		131,300	130,700
Eastern	47,000		47,000	46,100
Florida	1,225		1,225	1,225
Illinois	233,200		233,200	229,500
Indiana	33,000		33,000	32,800
Kansas	†336,000		†336,000	†344,075
Kentucky	41,600		41,600	41,000
Louisiana	798,100	86,550	884,650	882,400
North	108,100	3,100	111,200	108,950
South	690,000	83,450	773,450	773,450
Michigan	22,400		22,400	26,200
Mississippi	102,900	3,800	106,700	106,700
Montana	77,800		77,800	77,100
Nebraska	58,200		58,200	58,000
Nevada	100		100	100
New Mexico	274,000	5,100	279,100	279,100
North Dakota	24,000		24,000	29,600
Oklahoma	†569,200		†569,200	†568,100
Texas	2,827,000	63,500	2,890,500	2,890,500
Dist. 1	48,000	500	48,500	48,500
Dist. 2	128,000	8,300	136,300	136,300
Dist. 3	374,000	31,500	405,500	405,500
Dist. 4	213,000	8,100	221,100	221,100
Dist. 5	34,000	375	34,375	34,375
Dist. 6	130,000	6,100	136,100	136,100
East Texas field	166,000		166,000	166,000
Dist. 7-B	155,000	75	155,075	155,075
Dist. 7-C	145,000	4,050	149,050	149,050
Dist. 8	1,115,000	2,000	1,117,000	1,117,000
Dist. 9	212,000	1,500	213,500	213,500
Dist. 10	107,000	1,000	108,000	108,000
Utah	96,800		96,800	97,400
Wyoming	325,300		325,300	324,100
Others	‡175		‡175	‡175
Total U. S.	6,940,270	159,130	**7,099,400**	7,105,425
Change from prev. week, down			**6,025**	
Canada	†458,600		†458,600	†459,200
Total U. S. prod., Jan. 1-Sept. 27			1,772,817,900 bbl.	
Same period last year (crude plus cond.)			*1,964,870,441 bbl.	

*Includes 37,671,400 bbl. condensate. †Week ended previous Monday. ‡South Dakota and Washington.

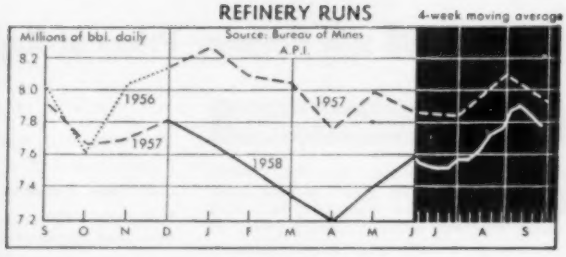
CRUDE-OIL PRODUCTION 4 week moving average



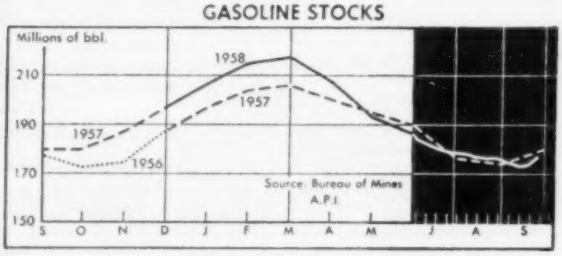
TOTAL DEMAND–ALL OILS 4-week moving average



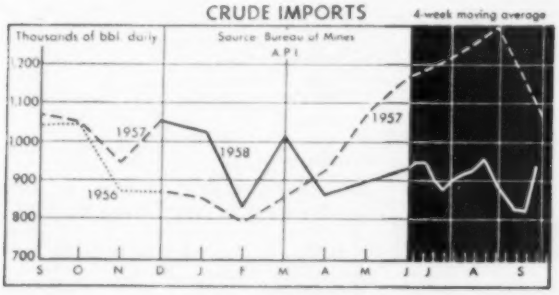
REFINERY RUNS 4-week moving average



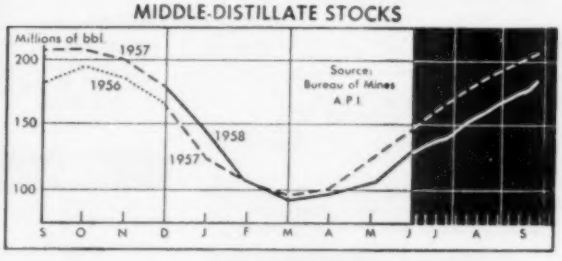
GASOLINE STOCKS



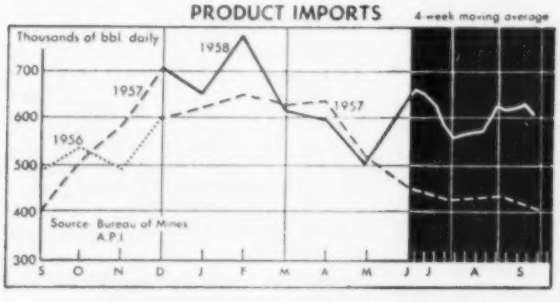
CRUDE IMPORTS 4-week moving average



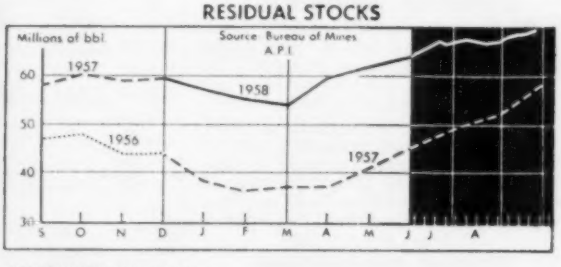
MIDDLE-DISTILLATE STOCKS



PRODUCT IMPORTS 4-week moving average



RESIDUAL STOCKS



API REFINERY REPORT, SEPTEMBER 26, 1958

(Thousands of barrels)

District—	Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.	Stocks‡ Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, September 1957 Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.
East Coast	1,136	578.6	36.7	315.3	234.6	39,958	11,617	54,341	13,224	1,170	513.8	20.7	308.1	193.9
Appalachian:														
District 1	104	47.3	5.3	19.1	6.3	4,410	596	3,414	319	108	47.2	2.3	25.1	6.5
District 2	88	47.6	5.6	21.7	5.1	2,450	499	1,503	183	101	53.4	6.0	16.8	9.6
Ind., Ill., Ky.	1,327	734.4	60.1	300.1	107.9	32,464	7,667	27,662	5,643	1,408	729.5	63.0	290.3	162.3
Minn., Wis., Dak.	70	31.0	1.6	24.0	8.3	6,870	1,478	8,546	532	61	25.1	1.6	20.2	7.0
Okla., Kans., Mo.	705	400.6	13.1	188.7	24.9	16,474	1,860	13,369	1,102	204	413.9	13.3	173.6	30.9
Inland Texas	246	187.0	12.6	49.9	20.6	6,708	402	1,915	2,022	283	215.9	7.4	52.1	22.7
Texas Gulf Coast	1,747	880.8	107.9	471.0	184.4	21,582	3,101	16,529	9,089	1,891	985.3	111.0	451.0	228.7
La. Gulf Coast	685	384.3	53.8	143.7	56.3	10,384	2,035	6,936	1,853	612	368.2	35.2	168.9	49.8
N. La. and Ark.	100	44.4	6.4	22.4	6.4	4,918	1,020	2,075	179	99	38.0	7.4	18.9	6.7
Rocky Mountain:														
New Mexico	19	14.3	0.6	3.0	1.1	474	13	139	42	25	13.9	0.4	5.2	3.3
Other Rky. Mt.	282	125.3	1.3	59.9	29.6	4,310	315	3,051	838	290	133.1	3.9	65.6	39.2
West Coast	1,130	489.8	1.1	163.3	319.4	22,479	339	14,153	34,569	1,168	520.0	3.9	176.3	338.9
Sept. 26, 1958	7,639	3,965.4	306.1	1,782.1	1,004.9	173,481	30,942	153,633	69,595	7,920	4,062.3	276.1	1,772.1	1,099.5
Sept. 19, 1958	7,604	4,001.4	285.9	1,758.6	985.1	173,158	30,011	149,461	68,893	.....	.....	.....	.....	.....
Sept. 27, 1957	7,918	4,061.1	224.6	1,755.4	1,132.7	177,430	36,331	169,265	57,716	.....	.....	.....	.....	.....

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.

Crude-Oil and Refinery Prices at Representative U. S. and Foreign Points

REFINED-PRODUCT PRICES

Following quotations are for refinery products in cents per gallon moving in interstate shipments on Wednesday each week unless otherwise noted. Crude-oil prices are per barrel at the wells unless otherwise listed.

GASOLINE*

Mid-Continent (Group 3):

Regular (89 octane)	11.75-12.25
Premium (99 octane)	14.75-15.25

Gulf Coast (cargoes for coastwise or export movements):

★ Regular (90 octane)	10.25
★ Regular (92 octane)	10.50
★ Premium (97 octane)	11.625
★ Premium (98 octane)	11.75

California (rack) (Los Angeles):

Regular (88 octane)	11.3-11.5
Premium (96 octane)	12.8-13.0
Premium (98 octane)	13.3-13.5

Caribbean area (cargoes):

★ Regular (87 octane)	9.875-10.125
★ Premium (97 octane)	11.625-11.875

*Quotations are for octanes shown. Prices usually vary with octane ratings within the regular, premium, and aviation grades.

NATURAL GASOLINE*

Group 3:

Grade 26-70	4.5

Breckenridge:

Grade 26-70	4.0

*If 26-70 natural is considered as 100%, prices for lower-vapor-pressure grades increase 2.5% for each unit drop in Reid vapor pressure down to and including 16 lb. Prices for grades below 16 lb. may vary slightly by areas or plants.

KEROSINE AND DISTILLATE

Mid-Continent (Group 3):

Kerosine 42-44	9.75-10.00
Diesel oil (58 d.i. and above)	9.50-9.75
Distillate No. 1	9.50-9.75
Distillate No. 2	8.75-9.00

Gulf Coast (cargoes):

Kerosine 41-43	8.875
Distillate No. 2	8.625

New York Harbor (barges):

Kerosine 41-43	9.95
Distillate No. 2	9.45
Diesel fuel, 48-52 d.i.	10.05

Caribbean area (cargoes):

Distillate No. 2	8.625

WAX (LB.)

Oklahoma (Group 3):

132-135 A.m.p. (semi-refined) in tank car	6.50

New York (export):

126-130 A.m.p. crude-scale (solid in bags or barrels)	7.35

★Denotes change from previous week.

RESIDUAL FUEL (BBL.)

Mid-Continent (Group 3):	
Residual fuel (max. 1% S)	$1.40-1.50
Gulf Coast (cargoes):	
★ Bunker C fuel	$2.00
New York Harbor (barges):	
★ Bunker C fuel	$2.37
Caribbean (cargoes):	
Bunker C	$2.00
California (rack):	
★ Bunker C fuel, Los Angeles	$2.10

LUBRICATING OILS

Mid-Continent (Group 3):	
150-160 bright stock, solvent refined, 0-10 p.p., 95 v.i.	23.0
200 vis. neutral oil, solvent refined, 0-10 p.p., 95 v.i.	20.5
Pennsylvania Grade:	
145-155 vis. at 210, bright stock, 8 color, 25 p.t.	22
200 vis. neutral (180° at 100°), 25 p.t.	21

CRUDE-OIL PRICES

GRAVITY SCHEDULE

	★Signal Hill, Calif.	Mid-Cont.*	Gulf Coast Tex.†	West Tex.‡ N.M.	Wyo. (sour)
14-14.9	$1.86				
15-15.9	1.95				$1.81
16-16.9	2.04				1.86
17-17.9	2.13				1.91
18-18.9	2.23				1.96
19-19.9	2.32				2.01
20-20.9	2.41	$2.75		$2.62	2.06
21-21.9	2.50	2.77		2.64	2.11
22-22.9	2.60	2.79		2.66	2.16
23-23.9	2.69	2.81	$3.44	2.68	2.21
24-24.9	2.78	2.83	3.46	2.70	2.26
25-25.9	2.87	2.85	3.48	2.72	2.31
26-26.9	2.96	2.87	3.50	2.74	2.36
27-27.9	3.06	2.89	3.52	2.76	2.49
28-28.9	3.11	2.91	3.54	2.78	2.54
29-29.9	3.16	2.93	3.56	2.80	2.59
30-30.9	3.22	2.95		2.82	2.63
31-31.9	3.27	2.97		2.84	2.67
32-32.9	3.33	2.99		2.86	2.71
33-33.9	3.38	3.01		2.88	2.75
34-34.9	3.44	3.03		2.90	2.79
35-35.9	3.49	3.05		2.92	2.83
36-36.9	3.55	3.07		2.94	2.87
37-37.9	3.60	3.09		2.96	2.89
38-38.9		3.11		2.98	2.91
39-39.9		3.13		3.00	2.93
40-44.9		3.15		3.02	2.95

*Includes Oklahoma (sweet), part of Kansas, North Dakota, West Texas (sweet). †Low cold test crude. ‡Sour.

Effective dates of broad changes: California, 9-30-58; east of California, January 3-10, 1957; Pennsylvania Grade, 6-18-58.

FLAT PRICES

Louisiana:	
Sweet Lake	$3.00
Ville Platte	3.30
Texas:	
East Texas	3.25
Conroe	3.53
Van	3.08
Pennsylvania Grade:	
Bradford	3.90
Middle District	3.72
Southwest Pennsylvania	3.43
West Virginia	3.25
Buckeye Grade	3.25
Illinois Basin	3.00
Canada:	
Leduc-Woodbend	2.67
Redwater (Alta.)	2.56
Smiley (Sask.)	2.33
Pembina	2.52

FOREIGN

Venezuela:	
Cumarebo, 48°-49.9°, Tucupido	3.75
San Joaquin, 41°-41.9°, Puerto La Cruz	3.34
Oficina, 35°-35.9°, Puerto La Cruz	3.05
Tia Juana medium, 26°-26.9°, Amuay*	2.55
Quiriquire, 16.0°-16.4°, Caripito	2.15
Lagunillas heavy, flat, Amuay or Las Piedras*	2.10
Bachaquero, flat, 15°-16°, Las Piedras*	1.93

Prices for all crudes of 24° or lighter vary 2 cents per degree change, up or down. All crudes heavier than 24° vary 2.5 cents per half-degree gravity change.

*Also available at La Salina at 3 cents per barrel less.

Middle East, Persian Gulf (cargoes, f.o.b. lifting port):	
Arabian, 36.0°-36.9°, Ras Tanura	$2.12
Iranian, 34.0°-34.9°, Bandar Masur	2.04
Iranian, 34.0°-34.9°, Abadan	1.99
Iraq, 35.0°-35.9°, Fao	1.98
Kuwait, 31.0°-31.9°, Mina-al-Ahmadi	1.85
Qatar, 41.0°-41.9°, Umm Said	2.23
Middle East, E. Mediterranean:	
Arabian, 36.0°-36.9°, Sidon	2.49
Iraq, 36.0°-36.9°, Tripoli, Banias	2.49
Far East (cargoes, f.o.b. Lutong, Sarawak):	
Seria Light, 37°	2.75

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Gulf-U.S.N.H., dirty (USMC—5%)	2.71
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MAGNETOMETER Askania Vertical temperature compensated ten gammas perfect condition $900.00. Box K-685, The Oil and Gas Journal, Tulsa, Oklahoma.

USED ROTARY DRILLING EQUIPMENT. Rigs, drill pipe, drill collars and accessory equipment. Inquiries appreciated. Harries Sales & Rentals, P. O. Box 1568, Odessa, Texas.

8" COUPLINGS with Dutchman, A-1 Shape, standard 8 thread line. Indiana-Ohio Pipe Co. P.O. Box 323, Decatur, Ind., Phone 34674.

3,000' TRAILER MOUNTED Rotary Rig, FXO pump GD, 3½" Drill pipe, 7 drill collars, 2 dog houses, complete in every detail ready to go. Box K-882, The Oil and Gas Journal, Tulsa, Oklahoma.

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3,700 ft. 7" 29#, LT&C, N-80, R-3
600 ft. 7" 32#, LT&C, N-80, R-3
9,000 ft. 2⅞" 6.5#, T&C, N-80, R-2

All API Youngstown seamless, in perfect condition.

Rothschild Oil Co.
12354 Lakeland Rd., Santa Fe Springs,
Phone RAymond 3-3357

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CABOT UNIT, Witte engine, 3,000 ft. casing, rods, three lease tanks, like new. Sabetha, Kansas. R. D. Swan, 818 Kennedy Bldg., Tulsa.

WALKER-NEER SPUDDER: 32 special. Light plant, dog house, tools complete. Clean —ready to work. Phone 20 or write Box 788, Drumright, Oklahoma.

PIPE FOR SALE—A quantity of 16", 18" and 20" O.D. good used pipe at a very low price. Must be sold immediately. Write, wire, or call, Tri State Pipe Company, P. O. Box 542, Bellaire, Ohio. Phone ORchard 6-1451.

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Smls., mill tested, app. 40' drl., beveled unused line pipe for sale.
19,000' 30" O.D. x .375", Gr. X-42
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5,600' 16" O.D. x .281", Gr. B
Also smaller amounts of 16", 20" and 24".

Contact: P. E. Bowman,
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402 Dauphin Building, Harrisburg, Pa.

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6—10 ft. x 40 ft. horizontal storage tanks. 30 psig design pressure API-ASME Code with ¼" shell and ¾" F & D heads. Walkway, stairway, saddle supports, relief valves and related fittings. Located near Freer, Texas. Considerably under replacement costs.

Contact R. G. Carlin
DELHI-TAYLOR OIL CORPORATION
Corrigan Tower, Dallas, Texas

FOR SALE EQUIPMENT

SECOND HAND Mining Equipment, 2 air receivers, compressor 6x7, 15 H.P. gas engine, air hammer, 60 pieces of ⅞ steel, pipes, bolts, valves, belts, fittings, 2 cyclone tilting furnaces, and other equipment. See at 2222 N. Fair Oaks, Altadena, Calif., SY 7-5889.

SACRIFICE SALE: Three seismograph drills; two Mayhew 1000 Combinations and one Franks Combination. Also three water trucks and three pickups; drill pipe, subs, tools. Contact H. S. Smith, Box 845, Seminole, Texas; phone PLaza 8-2232.

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L844-52-42 Cooper Double Drum, Skid Mounted, Front Air Controls, Spudding Equipment; Cathead with Model LDDS Allis Chalmers Engine Complete with Gas-Gasoline Carburetor. *(Used on one well only).*

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Model "E" Allis Chalmers Single Drum Pulling Unit, Tractor Type, Good Rubber, Hydraulic Steering. *Never used since complete overhaul.*
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Phone: LUther 7-6561

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1 Reboiler 165 sq. ft.
1 Passenger Elevator 182 ft.
4 Cent. Pumps, 3000 GPM 200 HP (2) 1500 GPM 125 HP—680 GPM 40 HP.
5 Steam Pumps 8 x 4 x 6
4½ x 4 x 6 — 8 x 4½ x 12
New Croloy 9 Tubing 2⅞ OD—3300 ft.
New Tubes for Petrochem Furnaces
Croloy 5 Pipe 200 ft. 20"—1100 ft. 8" 250 ft. 6"
CAT D6 Tractor 74" GA, 16" Shoes
8500 Gal. Ethyl Blending Plant
100 Station Automatic Telephone Eqpt.
200 Ton Used BC Socony Catalyst
2700# Du Pont Antioxident
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WANTED: Will buy your surplus stocks of brass or steel Seamless Condenser tubes. Mail inventory, stating condition of material and asking price to Box K-639, The Oil and Gas Journal, Tulsa, Oklahoma.

WE ARE INTERESTED in purchasing a D-6 Caterpillar or equivalent with side boom. Cat. to be in good operating condition. Write to Roy Gearhart, Box 710, McPherson, Kansas, or telephone 481 at McPherson.

TRAILER MOUNTED drilling rig capable of 3,000' drilling with 3½" pipe. Must be in good condition. Send full particulars first letter, price, location, condition & other pertinent data. Box K-881, The Oil and Gas Journal, Tulsa, Oklahoma.

HELP WANTED

COMBINATION general manager, drilling superintendent and petroleum engineer, to supervise foreign one rig operation; top salary and bonus. We want complete background and references. All replies held strictly confidential. Box K-867, The Oil and Gas Journal, Tulsa, Oklahoma.

ACCOUNTANT

Age 34—B.S. Actg.—Experienced all phases production accounting including management & auditing. Desires to relocate.

BOX K-896,

THE OIL AND GAS JOURNAL,
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Large Independent Oil Company,

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has opening for man, age 35-40, to negotiate participation factors in secondary recovery units; prepare and secure execution of unit and operating agreements; serve as chairman of operators meetings. Qualifications include land experience; good practical knowledge of engineering and various forms used in unit and operating agreements. Submit details regarding personal data, education, experience, and salary requirements. All replies confidential. Write:

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ELECTRONICS ENGINEER—design and packaging of electric circuitry for oil industry by established manufacturer of oilfield equipment. Will contact customers and technical people in Southwest, keep up with trends and new developments. Should have degree in EE and minimum of 3-4 years experience in the field. Send resume of qualifications to Box K-893, The Oil and Gas Journal, Tulsa, Oklahoma.

ENGINEER—Petroleum or chemical degree for sales and service of oilfield equipment in Europe. Should speak French and English, prefer minimum of 4-5 years of industry experience. Send resume of qualifications to Box K-892, The Oil and Gas Journal, Tulsa, Oklahoma.

FOREIGN EMPLOYMENT. List oil companies, drilling contractors, seismograph contractors, showing where apply foreign jobs, $5.00 cash. OIML Co., Box 2603, Tulsa, Okla.

REPRESENTATIVE to sell Oil Tool Equipment to drilling companies and refineries. Good territories available. Experienced representatives preferred. Box 31J402, The Oil and Gas Journal, 4041 Marlton Ave., Los Angeles 8, Calif.

GENERAL SALES MANAGER wanted by aggressive petroleum marketing company with headquarters in Tulsa. Must be experienced in sales promotion, well known in the industry and have full knowledge of specifications of petroleum products as well as pricing schedules. Some traveling necessary. Excellent opportunity with chances for advancement for right man. Please reply Box K-855, The Oil and Gas Journal, Tulsa, Oklahoma, giving age, qualifications, references and expected starting salary. All replies will be treated strictly confidential.

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The Oil and Gas Journal,

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SITUATION WANTED

PETROLEUM and Mechanical Engineer, twenty years professional experience of which ten with Y. P. Fiscales, Argentina. Want to work with an American oil company, in South America, Argentina especially. Argentine native citizen, age 45, married. Read English, Portuguese. Box K-895, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST-GEOPHYSICIST, 30 years, family, five years diversified experiences in France and French colonies wants situation in South America, U.S.A. or Canada. Box K-894, The Oil and Gas Journal, Tulsa, Oklahoma.

CHEMIST: B.S. degree. 12 years oil company lab experience. Age 34. Desire position with advancement possibilities. Box K-886, The Oil and Gas Journal, Tulsa, Oklahoma.

SALES ASSISTANT WANTED

EXCELLENT POSITION OPEN FOR SALES ASSISTANT, with expanding and long established firm. Must have a working knowledge in all phases of tank manufacturing and distribution, such as: Branch operations, quotations, sales orders, billing, inventory and customer relations. Also a knowledge of all types of equipment, including treaters, separators, low temperature extraction and dehydrators. All replies confidential. Salary commensurate with ability.

Box K-889, The Oil and Gas Journal, Tulsa, Oklahoma.

SITUATION WANTED

PETROLEUM ENGINEER, 32, single, speak Spanish and German. 2 years foreign, 2 years U. S. experience. Prefer Latin America or Europe. Box K-890, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER: 38; 14 years diversified engineering experience in production (both oil and gas) drilling workovers; oil and gas reserve estimates; and wells tests. 12 years in Texas Gulf Area; last 2 years in South America as Chief Engineer for major. Prefer to live in Houston. Will travel anywhere. Registered. Excellent references. Box K-885, The Oil and Gas Journal, Tulsa, Oklahoma.

PRODUCTION SUPERINTENDENT: Age 41. Experience 20 years, all phases production, drilling, completion and maintenance, desires position with Independent Company. Excellent references. Will consider any location. Box K-878, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM GEOLOGIST - ENGINEER, 28, four years Rocky Mountain experience in exploration, development. Presently employed. Desires position with aggressive independent or consulting firm in Denver, Colorado. Box K-871, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST - GEOPHYSICIST, 30, B.A Math, M.S. Geology, 6 years interpretative experience with major, desires position with consulting or small oil firm with exploration department. Detailed resume on request. Box K-830, The Oil and Gas Journal, Tulsa, Oklahoma.

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LEGAL

SEALED BIDS will be received until 10:00 A.M., Mountain Standard Time, October 22, 1958, and opened at that time in the office of the Navajo Indian Agency, Window Rock, Arizona, for oil and gas leases on 85 tracts of allotted lands, totaling approximately 13,551 acres, located in McKinley, San Juan and Sandoval Counties, New Mexico.

Details of the lease offering and filing of bids may be obtained by addressing an inquiry to the General Superintendent, Navajo Indian Agency, attention: Branch of Realty, Window Rock, Arizona.
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TO BE SOLD SOON, privately or publicly, N½, Sec. 3, Twp. 19 N, R 1 W of I M, Payne Co., Okla. Part of estate of Eugene B. Hickman. On Highway 86, 8 mi. south of Perry, 13 west and 4 north of Stillwater. Lake Carl Blackwell borders at points on south. 90 acres cultivated. Conveniently located well has produced plenty of water for 50 years. Never drilled on for oil or gas. Old, producing wells within sight. Write Loren Moore, Executor, 811 S. Ash, Ottawa, Kansas.

LEASE AND DRILLING BLOCKS

FOR DRILLING DEALS in Texas, contact Ogden Oil Company, P. O. Box 464, Ph. EL 2-3352, Taylor, Texas.

FOR SALE: 480 acres oil lease Linn County, Kansas, 11 wells, room for 40 more. Ideal for water flood. H. J. Lynch—Osawatomie, Kansas—Phone P.L. 5-2296.

OIL MINERAL LEASES: Are you interested in 12,000 acre block, Aiken County, S. C. Good prospects for oil. Curtiss Williams, 745 20th St., Boulder, Colorado.

WANTED—Any size oil and gas production, royalties, overrides and abandoned leases for salvage. Box K-887, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED—Oil & Gas Royalties for Investment. Commonwealth Trust Co. P. O. Box 350, Wilmington 99, Delaware.

500 ACRE DRILLING BLOCK. Pawnee County, Oklahoma. Nearby production. Box K-858, The Oil and Gas Journal, Tulsa, Oklahoma.

CUBAN COMPANY controlling 3½ million acres of petroleum rights desires to contact U. S. or Canadian Corporation interested in Cuba's oil future. Maps and data available to the right party. Write to M. A. Noguera, 23rd #53 St. Vedado, Havana, Cuba.

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Box K-884, The Oil and Gas Journal, Tulsa, Oklahoma.

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LEGAL

SEALED BIDS will be received until 2:00 P.M. Mountain Standard Time, October 28, 1958, and opened at that time in the Office of the Uintah and Ouray Indian Agency, Fort Duchesne, Utah, for the leasing of 33,874.53 acres of Tribal land and 1,020.6 acres of allotted Indian land, located in Townships 2 and 3 South, Ranges 3, 4, 5 and 6 West, Duchesne County, Utah, for oil and gas mining purposes. The details of the lease offering and how and where to file bids may be obtained by addressing the inquiry to the Superintendent of the Uintah and Ouray Indian Agency, at Fort Duchesne, Utah.

LEGAL

NOTICE TO BIDDERS

Sealed proposals in duplicate, addressed to the City Commission, City of Port Arthur, Texas, will be received at the office of the City Clerk until 9:00 o'clock A. M., October 15, 1958, and then publicly read at 10:00 o'clock A. M. on the same date for the leasing for a period of twice not exceeding three (3) years for oil and gas the following described tract of land, the same being located in the County of Jefferson, Texas, and within the Corporate Limits of the City of Port Arthur: Lots 1, 2, 7 & 8, Block 8, Range M of the Port Arthur Land Co. Lots 2, 3, 4, 5 & 6 Block 8, Range L of the Port Arthur Land Co. Proposals shall contain the provisions that no well or wells will be drilled on any part of said above described property that is covered by water and that any well or wells drilled beneath that part of said property covered by water will be drilled by the use of directional drilling and shall in no way injure the water contained in the reservoir located on City Property. Each Proposal shall be accompanied by a certified check drawn on a bank acceptable to the Owner, or bidders bond from a surety company acceptable to the Owner, in an amount not less than 5% of the total bid price, payable without recourse to the City of Port Arthur as a guaranty that the successful bidder (s) will enter into a lease contract. Successful bidders shall furnish an indemnity bond indemnifying the City of Port Arthur for any loss or losses, damage or damages that might be sustained by reason of the drilling of a well or wells on or under said property. Bid sureties will be returned to all but the lowest acceptable bidder within five (5) days after opening of bids and the successful bid sureties will be returned within twenty-four (24) hours after the execution of the lease contract. The City of Port Arthur as Owner reserves the right to reject any or all bids. Ernest W. Meyer, City Clerk.

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Kellogg Co., The M. W. 25
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Lane-Wells Company Inside Front Cover
Larkin Packer Company, Inc. 311
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Manhattan Rubber Division, Raybestos-Manhattan, Inc. 238, 239
Manning, Maxwell & Moore, Inc. 244
Marbon Chemical Division of Borg-Warner 193
Massey-Ferguson Industrial Division 31
Mathey Machine Works, Inc., C. A. 301
McDonough Marine Service 235
McKissick Products Corporation 211
Metallurgical Products Department of General Electric Company 70
Mid-Continent Supply Company 23, 77
Mission Mfg. Company Inside Back Cover
Mixing Equipment Co., Inc. 246
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Mountain Iron & Supply Company 167
National Bank of Commerce, The 73
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National Steel and Shipbuilding Corporation 215
National Tank Company 332
National Tube Division 248, 249
Nordstrom Valve Division, Rockwell Manufacturing Company 21, 22
Norris Manufacturer, Inc., W. C. 4
Oil Center Tool Co. 80
Oil Well Supply Division 6
Olin Mathieson Chemical Corporation 19
Paris Distributor, Inc., Henry H. 316
Perforating Guns Atlas Corporation 295
Permian Basin Oil Show 312
Petreco A Division of Petrolite Corporation 276
Petro-Chem Development Co., Inc. 280
Petroleum Electric Power Assn. 60
Petroleum Equipment Supplies Association 219
Pfizer & Co., Inc., Chas. 223
Pittsburgh Steel Company 78, 79
Porter Company, Inc., H. K. Forge and Fittings Division 210
Price Company, H. C. 96
Producers Supply & Tool Co., The 304
Raybestos-Manhattan, Inc., Manhattan Rubber Division 238, 239
Reed Roller Bit Company 188, 189
Reliance Electric and Engineering Co. 75
Republic Steel Corporation 269, 271, 273, 275, 277, 279, 281
Resistoflex Corporation 41
Reynolds Metals Company 252, 253
Ridge Tool Company, The 284
Robbins & Myers, Inc. 310
Rockford Clutch Division of Borg-Warner Company 302
Rockwell Standard Corporation 11
Roebling's Sons Company, John A. 34, 250
Rollway Bearing Co. 68
Sargent Engineering Corporation 102
Schlumberger Well Surveying Corp. 91
Scott-Rice Company 216
Security Engineering Division, One of The Dresser Industries 8
Servco 53
Shaffer Tool Works 306
Sherman Products, Inc. 88
Smith Oil Tool Co., H. C. 234
Smithco Engineering, Inc. 227
Southern California Oil Tool Company 235
Southern Marine & Aviation Underwriters, Inc. 203
Southwestern Graphite Co. 213
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Sperry-Sun Well Surveying Company 173
Standard Oil Company of Indiana 55
Standard Oil Company (New Jersey) 254
Stewart & Stevenson Services, Inc. 66, 67
Struthers Wells Corporation 44
Taylor Forge & Pipe Works 38, 39
Technical Oil Tool Corporation 315
Tennessee Corporation 274
Texas Company, The 240
Texas Employers Insurance Association 65
Tex-Tube Inc. 92
Thermoid Company 297
Thomas Flexible Coupling Co. 282
Thompson Pump Company 200
Thompson Tool Co. 305
Thornhill-Craver Co. 35
Toronto-Dominion Bank, The 209
Torrington Company, The 309
Tretolite Company A Division of Petrolite Corporation 49
Tri-State Oil Tool Co., Inc. 274
Tuboscope Company 10
Tulsa Paper Company 279
Union Carbide Chemicals Company, Division of Union Carbide Corporation 29
Union Wire Rope Corporation 86, 87
United States Rubber Company 89
United States Steel Corporation 82
American Steel & Wire Division 62, 63
National Tube Division 248, 249
Oil Well Supply Division 6
Universal Atlas Cement Co. 199
Victaulic Co. of America 307
Viking Pump Co. 212
Vogt Machine Co., Henry 48
Wagner Electric Corporation 247
Wash Overshot & Spear Engineers, Inc. 33
Waukesha Motor Company 272
Well Completions Incorporated 214
Well Equipment Mfg. Corp. 204
Well Instrument Developing Co., Houston 216
Western Supply Company 233
Wheland Company, The 74
Wickwire Spencer Steel Division, Colorado Fuel and Iron Corp. 24
Williamson, Inc., T. D. 232
Wilson Manufacturing Co., Inc. 28
Wisconsin Motor Corporation 308
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Worthington Corporation 283
Youngstown Sheet and Tube Company 164, 165
Zink Co., John 212

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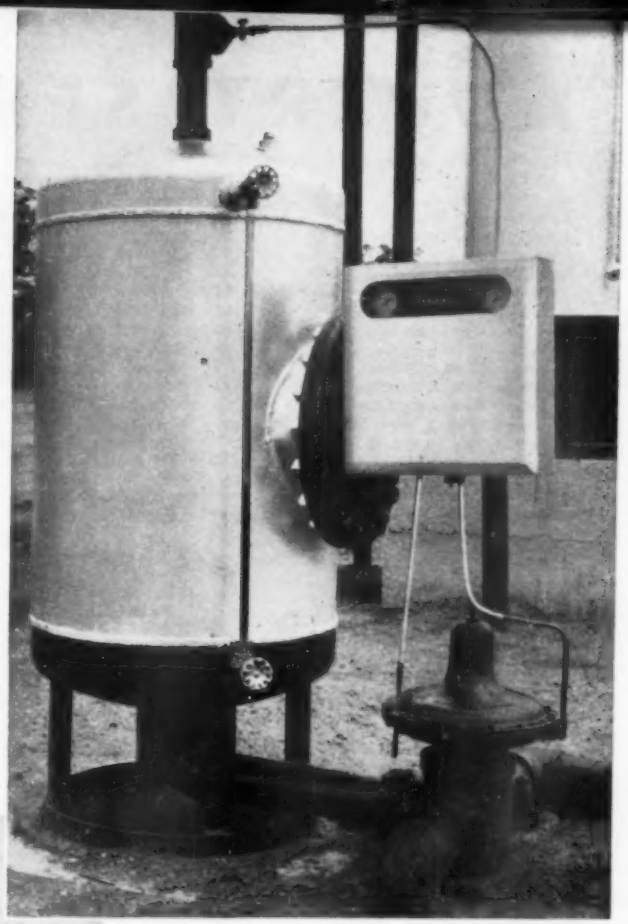

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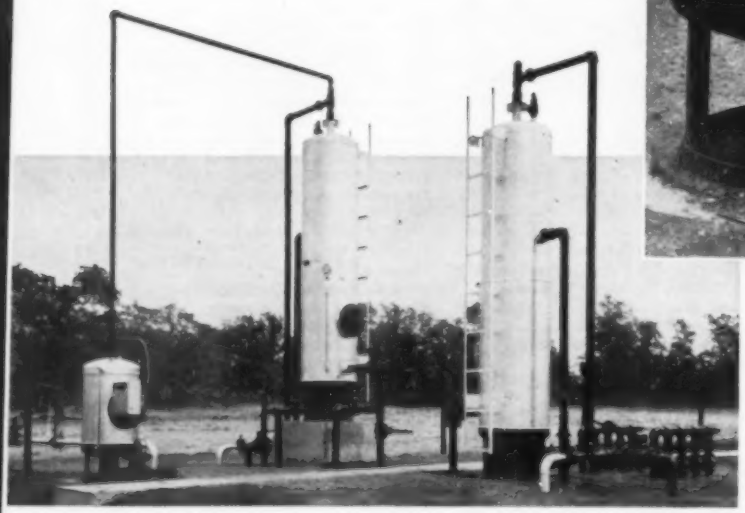

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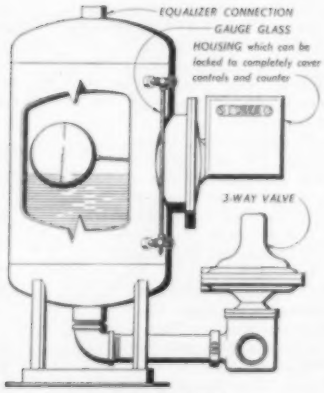

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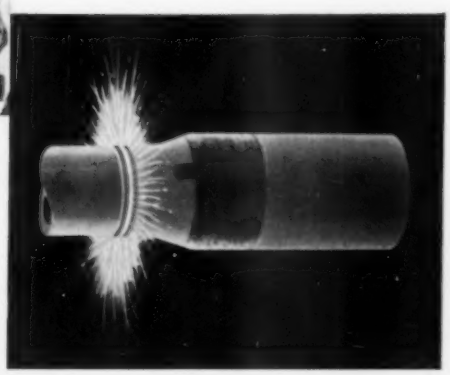

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